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REGIONAL INNOVATION SYSTEM DEVELOPMENT IN SELECTING COMPETITIVE PRODUCT FOR KABUPATEN BOYOLALI USING MULTI-CRITERIA DECISION-MAKING (ELECTRE-I) AND VALUE CHAIN ANALYSIS

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TUGAS AKHIR – TI 141501

PENGEMBANGAN SISTEM INOVASI DAERAH DALAM PENENTUAN KOMODITAS UNGGULAN UNTUK KABUPATEN BOYOLALU DENGAN MENGGUNAKAN *MULTI-CRITERIA DECISION-MAKING* DAN *VALUE CHAIN ANALYSIS*

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APPROVAL SHEET

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ABSTRACT

Regional Innovation System is a set of institutions whose interactions determine the innovative performance of national economic. In many developing and developed country, including Indonesia, the innovation system run by an excellent three integrated contributors called Triple Helix system. Triple Helix consist of business performer, government, and research and development. In Indonesia, the innovation system already narrowed down into regional innovation system. However, the integration of triple helix system in many region in Indonesia is not efficient enough to support the country's development. One of the region that has the potential to push the regional system is Boyolali regency. Located in a strategic location in Middle Java. One of the reflection of good triple helix system is how to manage the competitive product to increase the region productivity. This research is intended to contribute as one of the triple helix contributor as research and development actors by determining the superior commodity in Boyolali regency using Multi-Criteria Decision-Making, where the alternatives is the selected commodities from prospective sector in Boyolali regency. The MCDM method used in this research is ELECTRE-I method, where the alternatives will be compared to each other for every criteria. After the selection of competitive commodity, this research will also develop strategy to increase the utilization of the competitive commodity using Value Chain Analysis, where the strategies developed based on the primary and supporting activities. The chosen commodity after the calculation is Dairy Cows Livestock commodity and the strategic development with value chain analysis creating Rp 217.500.000,00 added value per every 300 lactation days per 28 dairy cows. Also the triple helix contributors to support the regency's innovation system is listed in the end of the research.

Keywords: ELECTRE-I Method, Location Quotient, Multi-Criteria Decision-Making, Regional Innovation System, Value Chain Analysis.

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PENGEMBANGAN SISTEM INOVASI DAREAH DALAM PEMILIHAN KOMODITAS UNGGULAN UNTUK KABUPATEN BOYOLALI DENGAN MENGGUNAKAN MULTI-CRITERIA DECISION MAKING (ELECTRE-I) DAN VALUE CHAIN ANALYSIS

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ABSTRAK

Sistem inovasi daerah adalah kumpulan institusi yang berinteraksi untuk menjalankan invovasi dari sebuah perekonomian Negara. Di banyak Negara maju dan berkembang, termasuk Indonesia, sistem inovasi dijalankan oleh tiga kontributor yang terintegrasi yang disebut *Triple Helix system. Triple Helix system* terdiri dari pelaku bisnis, pemerintahan, dan badan penelitian dan pengembangan. Di Indonesia, sistem inovasi sudah dikerucutkan menjadi sistem inovasi daerah. Namun, integrasi dari *Triple Helix system* di banyak daerah di Indonesia belum menemukan interaksi yang cukup baik untuk mendukung perkembangan Negara. Salah satu daerah yang memiliki potensi untuk memilkiki sistem inovasi daerah yang lebih baik adalah Kabupaten Boyolali. Terletak strategis di Jawa Tengah. Salah satu cerminan bahwa sebuah daerah memilki sistem inovasi yang baik adalah bagaimana cara daerah tersebut menggunakan produk unggulannya untuk keuntungan daerah. Penelitian ini ditujukan untuk berkontribusi dalam *Triple Helix system* sebagai peneliti dan pengembang dengan meningkatkan produktivitas komoditas unggulan di Kabupaten Boyolali dengan menggunakan metode *Multi-Criteria Decision-Making,* dimana alternative adalah komoditas prospektif di Kabupaten Boyolali. Metode MCDM yang digunakan adalah ELECTRE-I method. Setelah pemilihan komoditas unggulan, penelitian ini akan mengembangkan strategi untuk meningkatkan produktivitas dengan menggunakan *Value Chain Analysis* dimana strategi disusun berdasarkan *primary activities* dan *supporting activities.* Dalam penelitian ini, komoditas unggulan yang terpilih di Kabupaten Boyolali adalah komoditas peternakan sapi perah dan berdasarkan pengembangan strategi yang dilakukan, menciptakan *added value* sebesar Rp 217.500.000,00 untuk setiap masa laktasi 300 hari per 28 sapi perah. Diakhir penelitian ini juga disebutkan aktor-aktor *Triple Helix system* untuk mendukung sistem inovasi daerah di Kabupaten Boyolali.

Kata Kunci : ELECTRE-I, Location Quotient, *Multi-Criteria Decision-Making*, Sistem Inovasi Daerah, *Value Chain Analysis.*

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Table of Contents

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LIST OF TABELS

LIST OF FIGURES

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CHAPTER I
INTRODUCTION

The first chapter of the research explains about the background of the research, problem formulation, objectives, benefits, scope of the research, which consist of the limitations and assumptions, and the report structure of the research.

1.1 Background

Nowadays, a well-being country will measured by the prosperity of their own society. The competitiveness of a country in the era of technology is how the country handles the dynamic growth of technology and implement the technology itself into the ideal condition to support the society prosperity. Natural resources of the country itself did not ensure the country would able to compete. The only way a country able to compete in the global is to process the natural resources into something more valuable and innovate using the latest technology available. That means the innovation system of a country will contribute much to the competitiveness of the country itself. The innovation system of the country from small region into national wide system will determine the superiority of the country to compete with others. The economic basis of this modern era has already shifted into the knowledge basis economy.

The Global Competitiveness Index 2014-2015 divide the stage of development of a country into three stages of development. The stages of development itself are factor-driven stage, efficiency-driven stage, and innovation-driven stage. In 2014-2015, Indonesia was categorized as efficiency-driven country with some of other developing country such as China, Thailand, and Timor-Leste. It shows that in Indonesia, the mindset of the system is to push the efficiency to the limit. While other developed country such as USA, Singapore, and many European countries already categorized as Innovation-driven country. The categorizing of the countries is based on the weight of GDP per capita usage. Below is the figure for the stage of development of a country.

	STAGE OF DEVELOPMENT				
	Stage 1: Factor-driven	Transition from stage 1 to stage 2	Stage 2: Efficiency-driven	Transition from stage 2 to stage 3	Stage 3: Innovation-driven
GDP per capita (US$) thresholds*	<2,000	2,000–2,999	3,000–8,999	9,000–17,000	>17,000
Weight for basic requirements	60%	40–60%	40%	20–40%	20%
Weight for efficiency enhancers	35%	35–50%	50%	50%	50%
Weight for innovation and sophistication factors	5%	5–10%	10%	10–30%	30%

Note: See individual country/economy profiles for the exact applied weights.
* For economies with a high dependency on mineral resources, GDP per capita is not the sole criterion for the determination of the stage of development. See text for details.

Figure 1. 1 Sub Index Weights for Stages of Development (Source: WEF, 2015)

Based on the measurement of global competitiveness in figure 1.1 by World Economic Forum (WEF), Indonesia ranked 34th globally in terms of competitiveness, ranked 4th in ASEAN after Singapore, Malaysia, and Thailand. The global competitiveness measurement by WEF is based on twelve pillars, which are institutions, infrastructure, macroeconomic environment, health and primary educations, higher education and training, goods market efficiency, labor market efficiency, financial market efficiency, technological readiness, market size, business sophistication, and innovation (WEF, 2015). As innovation is one of the pillars to reach competitiveness globally, innovation system is one of the approaches to achieve well-utilized knowledge and technology to build the economy. The innovation system integrates all the innovation actors by considering both pull and push technology.

In Indonesia, the research about innovation was directed to Sistem Inovasi Nasional (SINas), SINas interpret innovation as a complex and systematic process that run by the government themselves. Beside, SINas also involve the industry as the business performer and research and development as the researcher. Those three elements also called as Triple Helix.

Innovation system is an integration of actor, institutional as the productive process that impact the development of innovation, and the learning process of the development. (Buku Putih, 2014). In the development of SINas in Indonesia, the government need to strengthen the pillars of SINas by developing the innovation in lower level, which later will be known as Sistem Inovasi Daerah (SIDa). SIDa related to the regional autonomy that identified by the industrial activity and the

policy released by the government. SIDa demonstrate that the smaller region considered as the proper scale for innovation research and develop better economy. Every region in Indonesia need to develop their own SIDa by understanding their advantages and optimized the productivity. That is the reason it needs further research and effort to reach the optimum and to have a stronger innovation system for each region. However, in the real condition, the role of research and development in SIDa have not optimized yet. In other countries that already categorized as an innovation-driven country, they have already achieve the synchronization of the triple helix. As one of the sub-system in the national innovation system structure, the research and education sub-system need to be more active to participate in the national innovation system. This research is intended to participate in one of the region in developing the regional innovation system.

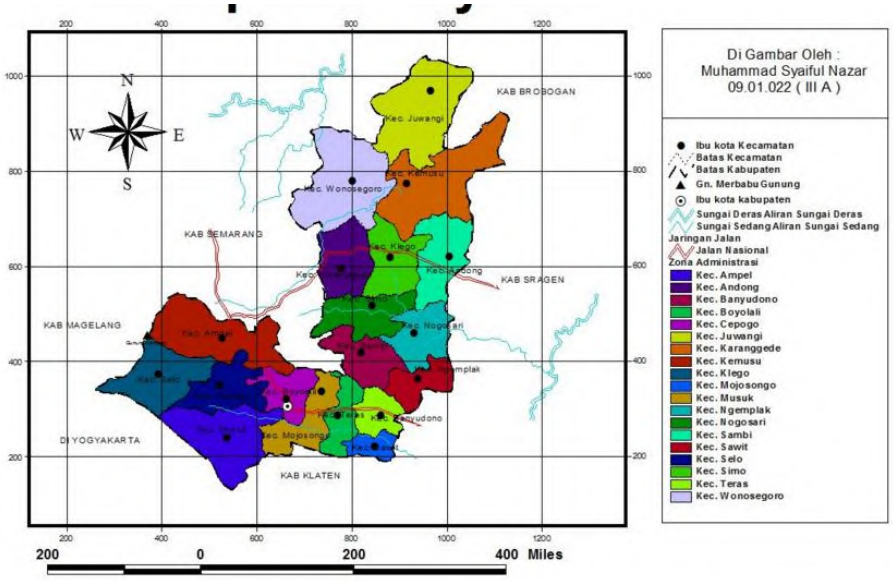

Figure 1. 2 Kabupaten Boyolali Map (Source: Boyolalikab.go.id)

Boyolali is one of a regency in Indonesia located in central java. Boyolali located between the lane of Solo and Surabaya. The total area of Boyolali is 1.105,1 km^2 and divided into 19 districts. The reason for assigning Boyolali as the object of the research is the regency potential in agriculture and processing industry. Year by year the proportion of agriculture and processing in regional gross domestic revenue is about 50% of domestic total (BKPM, 2012). The regency itself already develops their own development and planning called BAPPEDA. BAPPEDA

Boyolali has their mission to compile integrated development system (BAPPEDA, 2014). As already mentioned, to reach an excellent integrated innovation system, all the actors of the innovation itself need to participate. Boyolali has not collaborate with educational institutional to achieve triple helix function.

Boyolali have several business sectors as their society livelihood. There are agriculture, plantation, fishery, services, and many other. Below as can be seen in the table is the Gross Regional Domestic Product of Boyolali in the previous year in percentage.

Table 1. 1 Boyolali Regency PDRB (Source: Boyolali Dalam Angka 2014)

Business Field		**2010**	**2011**	**2012**	**2013**	**2014**
(1)		%	%	%	%	%
1	Agriculture, Forestry, and Fisheries	25,34	25,30	24,99	24,73	23,10
2	Mining and Excavation	4,15	4,08	3,93	3,85	4,32
3	Processing Industry	25,40	26,18	26,65	26,99	27,97
4	Electricity and Gas	0,02	0,02	0,02	0,02	0,02
5	Water Distribution, Waste Processing and Recycling	0,08	0,07	0,06	0,06	0,06
6	Construction	6,88	6,43	6,50	6,31	6,42
7	Large Scale Retail and Vechile Reparation	15,31	15,14	14,32	14,08	13,52
8	Transportation and Warehouse	4,16	4,13	4,26	4,68	5,01
9	Tourism	2,92	2,79	2,67	2,55	2,60
10	Information and Communication	2,48	2,45	2,40	2,30	2,31
11	Finance and Insurance	2,37	2,27	2,34	2,30	2,25
12	Real Estate	1,19	1,14	1,10	1,07	1,08
13	Service Company	0,29	0,30	0,30	0,32	0,32
14	Government Administration and	3,25	2,96	2,99	2,91	2,79
15	Education Service	3,52	4,21	5,01	5,34	5,63
16	Health Service and Social Activity	0,76	0,79	0,86	0,87	0,92
17	Other Services	1,90	1,74	1,59	1,62	1,70

Table 1. 2 Boyolali Regency PDRB (Source: Boyolali Dalam Angka 2014) (Cont)

Business Field	2010	2011	2012	2013	2014
(1)	(2)	(3)	(4)	(5)	(6)
Gross Regional Domestic Product	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**

As can be seen in the table 1.2 , Boyolali biggest production sector is agriculture, forestry, fisheries, and processing industries, which contribute more than 50% of domestic production. Based on those several business sector, there are many commodities grow in Boyolali. A good innovation system will focus on the competitive commodity to be more effective.

At the moment, Boyolali still developing the regency based on many product. The districts in Boyolali tries to maximize their own potential and give the best contribution to Boyoali development. However, to create an integrated innovation system in the scope of Boyolali regency, the districts need to integrate to focus on development of one featured competitive product. Beside developing their own product in the district, the districts in Boyolali need to coopperate to create the icon of the regency. There are still many factor that hinder this integration. For example production factor, infrastructure factor, or human resource factor. This research have the intention of creating strategies to improve the competitive product utilization.

To support Boyolali determine the competitive commodity, there are several industrial engineer knowledge to use. Determine the competitive commodity started by specifying the criteria in advance. The development of competitive commodity will also lead to strengthening the regional innovation system of the regency. The development will focus on determining and develop the competitive commodity based on the potential of the territory. The identifying method will be Location Quotient (LQ) by comparing the production of the commodities. After the data already narrowed to competitive commodities, the method used to determine the

competitive product is ELECTRE, which is one of the methods to determine the best alternatives in multi-criteria decision-making. After determining the competitive product of the region, to increase the productivity and marketing, this research will use Value Chain Analysis. By developing better competitive commodities, Boyolali expected to have better competitiveness and increase the society welfare.

1.2 Problem Formulation

Based on the background, the problem formulation that will be solved by this research is the development of integrated innovation system in Boyolali based on region's favorable competitive commodity.

1.3 Objectives

Based on the problem formulation, the objectives of this research are:

1. Determine the competitive commodity in the regency to develop regional innovation system.
2. Evaluate the activities of competitive commodity to be more productive and generate strategies to support the utilization of competitive commodity.

1.4 Benefits

Benefits that will acquired through this research are:

1. Utilizing industrial engineering knowledge to especially in knowledge and innovation management in a region.
2. Contribute in the development of innovation system, particularly in the region as the object of this research

1.5 Limitation

The limitation of this research are:

1. The scope of this research focused on regional innovation system strategy and development of potential commodities especially in agriculture and processing industry.
2. The data and observation of the research based on a valid data from the government organization of Boyolali regency.
3. The strategy developed in this research only addressed until suggestion to the object.

1.6 Assumption

The assumption of this research are:

1. During the research, there are no change in the regional policy about regional innovation system in Indonesia.
2. The calculation data and strategy developed in this research is intended to the government and later applied to the regency. The appraisal from the government sides is assumed ideal for the research.

1.7 Report Structure

The structure of this research report will be described as follow.

CHAPTER I: INTRODUCTION

The first chapter of this research explains about the fundamental of the research, which are the background of the research, research problem formulation, research objectives, the benefits obtained by doing this research, limitation and assumption in the research, and the report structure.

CHAPTER II: LITERATURE REVIEW

The second chapter of the research is the beginning of the research. This chapter will describe the theory that supports the research and resolve the problem.

The literature obtained from various sources such as books, journal, and internet or online sources.

CHAPTER III: RESEARCH METHODOLOGY

The third chapter of this report describe the systematic procedure of the research to resolve the problem. The procedure that already assigned will be the guidance through the research and a flowchart will visualized the research methodology.

CHAPTER IV: DATA COLLECTION AND PROCESSING

The fourth chapter of this report contains all the data and data processing needed to conduct the research. Researcher is gather the data from the object of the research as the mandatory to resolve the problem. The data later will be processed using methods that already mentioned.

CHAPTER V: ANALYSIS AND INTERPRETATION

The fifth chapter of the report consists of analysis and interpretation of the processed data in the previous chapter. Based on the data analysis and interpretation, researcher will conduct the research conclusion.

CHAPTER VI: CONCLUSION AND RECOMMENDATIONS

The sixth chapter of the report explains the research result based on the objectives of the research. The recommendations are also given to both the region as the research object and future similar research in the future.

CHAPTER II
LITERATURE REVIEW

This chapter explains the fundamental theories and literature review that used during the research. The literature review used in this research that also discussed in this chapter are the innovation system concept, superior product criteria, territory potential measurement, value chain analysis, and research position.

2.1 Innovation System Concept

Innovation comes from Latin, which is *innovare* that means a new way to utilize something or a new tool to create new value (Kadiman, 2008). Many countries developing policy and institution to develop their innovation capability. The concept of innovation system refers to national capability, not only the capabilities of some certain organization or individuals. As one of many illustrations, an economic Richard Nelson defines innovation system as a set of institutions whose interactions determine the innovative performance of national economic. In the end, a particular innovation system will create a multi-dimension, cross-sector, and involve all the elements of social system. This century already argued as a knowledge-based society, which means the generation will be characterized, based on the appropriation of the new technologies. From this background, many countries especially developed country establish a concept, which is National Innovation Concept. Many studies are intended to intensively research about National Innovation System. However, there has been no particular method to formulate National Innovation System. On the other hand, based on the concept of National Innovation System, the focus changed over into the development of Regional Innovation System, where the policy and institute able to focus analyzing on a smaller region.

2.1.1 Indonesia Innovation System Concept

In Indonesia, the development of competitiveness between regions is very important to consummate the society welfare nationally. In order to build comprehensive innovation in national development, the collaboration of innovation actors used as the key to increasing the competitiveness. Regional Innovation System (SIDa) is the main strategy to accommodate the interaction process between the innovation system components. Based on constitution of Indonesia in UU No. 17 tahun 2007 about long-term national development plan 2005-2025 and UU No. 17 tahun 2002 about national research system, knowledge application, and technology. Every region in Indonesia need to run several important point about regional innovation system. The important point to strengthen the regional innovation system are to develop coordination team and roadmap of the regional innovation system.

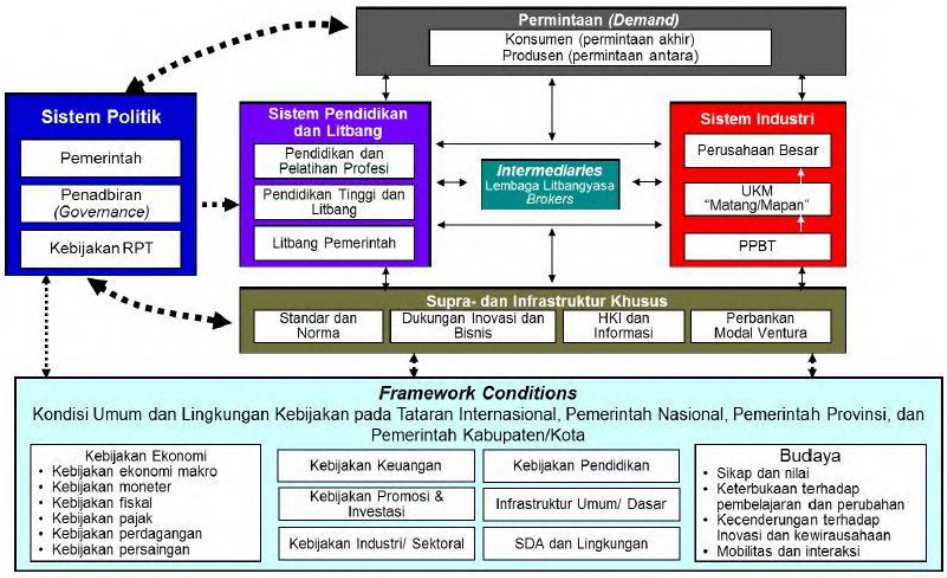

Figure 2. 1 Indonesia National Innovation System (Source: BPPT, 2015)

Based on figure 2.1 by BBPT, there are several action about regional innovation system implementation as:

1. Regional Innovation System Pillars Regulation

   The main idea of this action is to reduce every regulation that hampers the development of innovation. Also a program called “Umbrella Program”

socialized by the government as a tools of interaction between innovation actors and funding resource.

2. Priority Development Focus

   This action is a comprehensive process with deep analysis about the policy applicable in the region.

3. Innovation Implementation Framework

   This activity related to strengthen the industrial cluster corresponding the priority focus of the region. The roadmap and all the activity is based on the data related to the activity. The data will be processed to generate information to make the roadmap (Taufik, 2005).

Figure 2. 2 Regional Innovation System Roadmap (Source: Buku Putih Nasional, 2014)

2.2 Competitive Product Criteria

The criteria of a competitive product of a regency need to be determined in order to increase the productivity of the best product produced by the regency. There are several perception of product criteria in order to categorize the product as

the superior one in the regency. According to Porter's diamond of national advantage, there are four advantages as can be seen in the figure

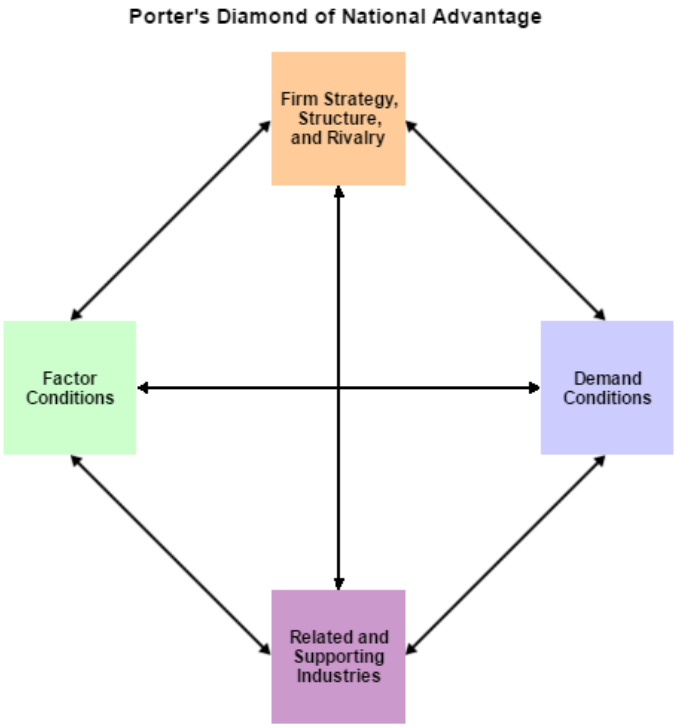

Figure 2. 3 Porter's Diamond of Advantage (Source: Mindtools, 2014)

There are four point of product advantages according to Porter as picture in figure 2.3, factors condition that include the production factor such as human resource and raw material, demand condition in local area, related and supporting industries to trigger more innovation, and firm strategy, structure, and rivalry. Also beside those four factors, the government as the secondary factors will take part to decide the product advantages. Below is the explanation of each factor in porter diamond of advantages

1. Factor Condition

   Factor condition advantages is obtained from when the product creates its own resources, the number of raw material is rich, and the innovation of this product leads to national comparative advantages.
2. Demand Condition

   When the demand condition in the home market is large, it will lead to better growth and innovation.

3. Related and Supporting Industries

   In the development of a product, it need supports from local industries. When the local industries more competitive, the firms will enjoy more cost effective and innovative outputs.

4. Firm Strategy, Structure, and Rivalry

   The structure and management in different countries will affect the competitiveness of a product. When the national firms is supporting such product, the development and innovation of the product will lead to better competitiveness. Rivalry also impact the advantages of the product.

Based on porter's theory of advantages, Ambardi and Prihawantoro developed the advatages of commodity in a regency. The advantages of the commodity will become the main driver of regency's development. The criteria of competitive commodities are:

1. Economy Driver

   Competitive commodity in a region need to become the prime mover of economy development. The contribution of the commodity can be displayed in the production, income, or the outcome of the commodity.

2. Other Commodities Relativeness

   Good commodity have good forward and backward linkages with other commodities. It will support each other to improve the region at overall.

3. Competitiveness

   Feature competitive commodity need to be able to compete with similar product in national or international market. The competitiveness could be in price, production cost, service quality, or many other aspects.

4. Other Region Relativeness

   The relation of competitive product with other region could be in market or raw material.

5. State of Technology

   Competitive commodity has consistent state of technology and its innovation in technology usage.

6. Employment

Competitive commodity has to absorbing labor optimally that suitable with its production scale.

7. Commodity Prospect

   The commodity need to be able to has long-term advantage to improve the region for long. In all the product phase from increasing to decreasing stage, the commodity has to be able to contribute in region's development.

8. Stability to Fluctiation

   The competitive commodity need to be able to survive from internal or external fluctuation in terms of economy, market condition, or environment.

9. Environment & Culture Support

   The competitive commodity need to receive support from environment and culture in the region.

2.3 Territory Potential Measurement (*Location Quotient)*

Location Quotient is a method used to quantify how concentrated an industry or commodities in a region compared to the national average. Location Quotient usually reveals the identity or uniqueness a particular region using a quantitative method. This research will identify whether the commodities in the region have superior production compared to national production in the similar commodities. Location Quotient uses several indicators to determine the growth of a region such as the Gross Regional Domestic Product or the employment in the region itself. LQ method adapted from Miller and Wright (2003), Isserman (1997), and Ron Hood (1998). According to Hendayana in 2003, LQ is a method to approach the economic growth in the simplest way even with its advantages or disadvantages. LQ technique is one of the first steps to understand the growing economic sectors. From an economic point of view, LQ method usually relevant to determine the superior commodity from the supply side. As already mentioned, LQ have it advantages and disadvantages. According to Hendayana, LQ is the simplest method to identify the superior commodity, yet adequately describe the real condition of the commodities. On the other hand, to obtain the best result, LQ

require accurate data of the real condition. So before the using the LQ technique, the data require to be tested by validation test.

Location Quotient method divided into Static LQ (SLQ) and Dynamic LQ (DLQ). In Static LQ, the data used is the exact data in the year of calculation. The equation used to obtain SLQ are:

$$SLQ = \frac{q_i/q_d}{Q_i/Q_r} \quad (2.1)$$

Information:

q_i = Total production of commodity i in the region

q_d = Total production of subsector in the region

Q_i = Total production of commodity i in the reference region

Q_d = Total production of subsector in the reference region

In Dynamic LQ, the calculation is consider the growth rate of the production in the region. The equation used to calculate Dynamic LQ is:

$$DLQ = \left[\frac{1+ g_i/1+ g_d}{1+ G_i/1+ G_r}\right]^t \quad (2.2)$$

Information:

g_i = Production growth rate of commodity i in the region

g_d = Production growth rate of subsector in the region

G_i = Production growth rate of commodity i in the reference region

G_r = Production growth rate of subsector in the reference region

t = Difference between last year and the first year.

The calculation of SLQ and DLQ will categorized the commodities into four different groups which are superior, prospective, mainstay, and less prospective. The qualification of each group can be seen in the matrix below

Tabel 2. 1 Sector or Commodity Potential Matrix

	DLQ > 1	**DLQ < 1**
SLQ > 1	Superior	Prospective
SLQ < 1	Mainstay	Less Prospective

(source: Ma'aruf, 2009)

Superior category is when the commodity or sector have better production than others and will become competitive for a long time. Prospective category is

when the commodity is better than others but projected will less competitive in the future. Mainstay category is when the commodity or sector is not productive enough currently, but have a good projection in the future to be competitive. While less productive is not productive enough currently and also have bad projection in the future.

2.4 Value Chain Analysis

A value chain is a series of activities that intended for create and build value by steps (Economictimes, 2014). The value chain concept was developed by Michael Porter through his book 'Competitive Advantage' in 1985. Value chain concept separates many useful activities from wasteful activities that will allow a company or organization gain more competitive advantages. In his book, Porter suggested that activities within a company consist of activities that should run in a very optimum level and add more value to its product or services. Value of a product or services will describe the customer willingness to pay. The value chain model by Porter considers each inputs, transformation process, and output of the activities. The generic model of Porter's value chain can be seen as:

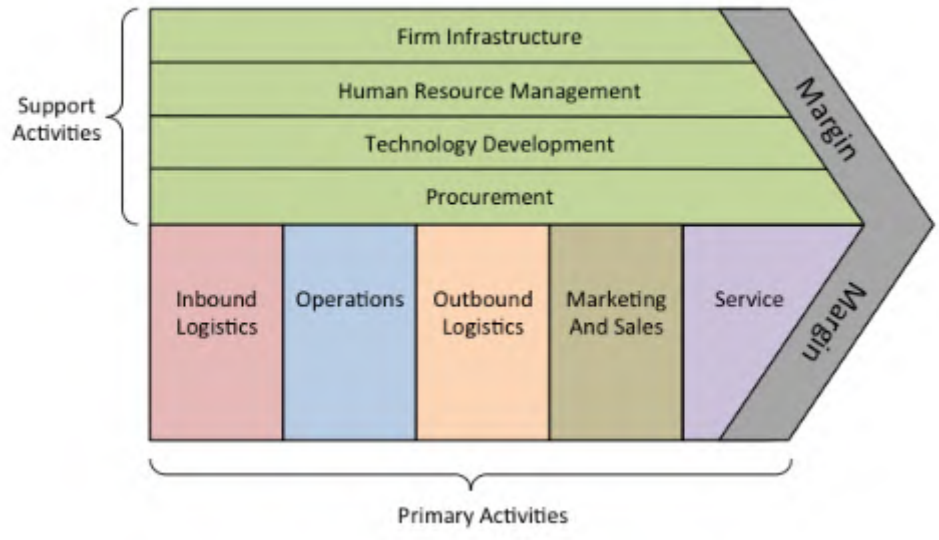

Figure 2. 4 Value Chain Model (Porter, 1985)

In Porter's value chain model in figure 2.4, the activities of a company divided into two activities categories, primary and support activities. Primary

activities is the company's activity that related to the creation, sale, and physical maintenance of the product or services. The primary activities is divided into five activities which is:

1. Inbound Logistics

   Inbound logistics is all process related to receiving, storing, and distributing. The most important factor in the inbound logistics is the supplier relationship.
2. Operations

   Operations is a physical process that transforms the inputs into the finished output that able to sell. This process usually creates most values to the product or services compared to other activities.
3. Outbound Logistics

   Outbound logistics is the delivery process of the product or services to the customer.
4. Marketing and Sales

   Marketing and sales is about how to persuade the future customer to choice the offered product. The source of value in this activities is the benefits offered by the product and also how to communicate with the customer.
5. Service

   Service is the last primary activities that related to maintaining the value of the product or services. How to keep the customer after the product sold to them.

The other activities of Porter's value chain is support activities. Support activities are the activities to support the primary activities to run effectively. The support activities are divided into four activities which are:

1. Firm Infrastructure

   Firm infrastructure is a company support system. The function of infrastructure is to maintain the operations of the company such as accounting, legal, management, and administrative. These activities able to provide more advantages to the company.

2. Human Resource Management

   Human resource management is the activities of how the company recruit and hire the company's worker. After hired the workers the company also need to train and reward the workers in order to keep the company run effectively.

3. Technology Development

   Technology development is related to the company managing information and protect the company knowledge base. The value created in this activities are minimizing the information technology cost and stay with the most updated technologies.

4. Procurement

   Procurement is related to what the organization does to reach the resource needed. The procurement activities will add value by finding vendors of the resource and negotiating the price.

2.5 Multi-Criteria Decision Making

Multi-Criteria Decision Making is one of the core of operation research to develop an approach to make optimal decision making. Typical MCDM problem deals with the evaluation of a set of alternatives and also set of criteria that considered to decision making (Triantaphyllou, et al, 1998). It is a branch of operations research models that deals with decision-making problems with multiple criteria to be considered. According to many authors, MCDM is divided into Multi-Objective Decision Making (MODM) and Multi-Attribute Decision Making. MODM techniques usually deal with problems that the decision space in continuous. While on the other hand, MCDM more concentrates on discrete decision space. All MCDM methods have three steps to utilizing the decision-making techniques. The first step is to determine the relevant criteria and alternatives, the second step is to attach the numerical measures to the relative importance of the criteria and to the impacts of the alternatives on these criteria, and the last step is to processing the numerical values to determine the ranking of each alternatives. To perform the last step of decision-making, there are several

methods can be performed. Each method has different characteristic and classified based on the type of data. Some examples of MCDM methods are Weighted Sum Model (WSM), Weighted Product Model (WPM), Analytic Hierarchy Process (AHP), ELECTRE method, and TOPSIS method.

2.5.1 Criteria Weighing Method

The criteria used in Multi-Criteria Decision Making need to be weighted before determining the best alternatives available. The criteria weighing method in this research is using Analytical Hierarchy Process and supported using PROMAX software. Analytical Hierarchy Process is one of decision support tool to solve complex decision problem (Triantaphyllou, 1995). It uses some multi-level hierarchical structure of objectives, criteria, sub-criteria, and alternatives. The hierarchy structuring is can be described as in figure 2.5

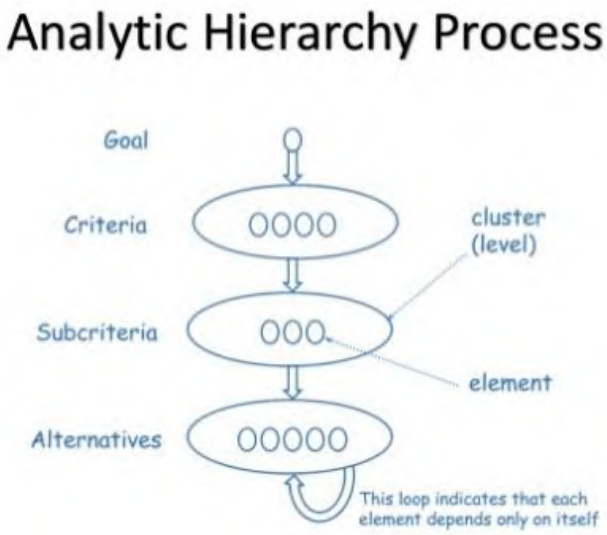

Figure 2. 5 Analytical Hierarchy Process (Source: Nikkhah, 2014)

After the hierarchy structuring, the next step of AHP is constructing a pairwise comparison matrices. Each elements in an upper level is used to compare the elements in the level immediately below with respect to it. However, in this research the calculation of priority weighing is done by the software PROMAX. In Promax software, the weight is calculated automatically by input the model hierarchy and pairwise scoring that filled by the expert.

2.5.2 ELECTRE Method

ELECTRE method is the acronym of *Elimination Et Choix Traduisant la Relite* or Elimination and Choice Expressing Reality. According to Janko and Bernoider (2005), ELECTRE is a decision-making method based on outranking concept with pairwise comparison of the alternatives based on each criteria. ELECTRE method used in a condition where an alternatives that less appropriate to the criteria will be eliminated one by one to get the best alternative. In other words, ELECTRE method is the best method to make a decision from many alternatives, but with limited criteria. An alternative dominate other alternative when one or more criteria is exceed another alternatives. In order to perform ELECTRE method, there are several steps to be performed, which are:

1) Normalizing the Decision Matrix

   In this procedure, each attribute transformed into comparable value. The equation to normalize X_{ij} is

   $$r_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{m} x_{ij}^2}} \; for \; i = 1,2,3,..,m \; and \; j = 1,2,3,..,n \qquad (2.3)$$

   So the *R* matrix is normalized as

   $$R = \begin{bmatrix} r_{11} & r_{12} & \dots & r_{1n} \\ r_{21} & r_{22} & \dots & r_{2n} \\ \vdots & & & \\ r_{m1} & r_{m2} & \dots & r_{mn} \end{bmatrix}$$

   R matrix is the normalized matrix. Where *m* is the alternatives, *n* is the criteria, and r_{ij} is the new and dimensionless preference measure of the *i-th* alternatives in terms of the *j-th* criteria.

2) Weighting the Normalized Decision Matrix

   After the normalization, every column of *R* matrix multiplied with the weight (w_j) by the decision maker. Therefore, the equation of weighted normalized matrix is-

   $$V = R \; x \; W \qquad (2.4)$$

$$\begin{bmatrix} v_{11} & v_{12} & \dots & v_{1n} \\ v_{21} & v_{22} & \dots & v_{2n} \\ \vdots & & & \\ v_{m1} & v_{m2} & \dots & v_{mn} \end{bmatrix} = \begin{bmatrix} w_1 r_{11} & w_2 r_{12} & \dots & w_n r_{1n} \\ w_1 r_{21} & w_2 r_{22} & \dots & w_n r_{2n} \\ \vdots & & & \\ w_1 r_{m1} & w_2 r_{m2} & \dots & w_n r_{mn} \end{bmatrix}$$

Where *W* equals

$$W = \begin{bmatrix} w_1 & 0 & \dots & 0 \\ 0 & w_2 & \dots & 0 \\ \vdots & & & \\ 0 & 0 & \dots & w_n \end{bmatrix}$$

3) Determine the Concordance and Discordance Sets

For every pairwise of alternative *k* and *l*, (*k, l =1,2,3,…,m* and $k \neq l$) sets of J criteria divided into two different subsets which are concordance and discordance. A criterion of alternative is concordance when:

$$C_{kl} = \{j, v_{kl} \geq v_{ij}\}, for\ j = 1,2,3, \dots, n \quad (2.5)$$

On the other hand, the complimentary subset is called the discordance when:

$$D_{kl} = \{j, v_{kl} < v_{ij}\}, for\ j = 1,2,3, \dots, n \quad (2.6)$$

4) Construct the Concordance and Discordance Matrix

To determine the value of each element in concordance matrix by sum up the weights in concordance set with this equation:

$$c_{kl} = \sum_{j \in c_{kl}} w_j \quad (2.7)$$

While the value of each element in discordance matrix obtained from dividing the maximum of criteria difference inside the discordance set with the maximum difference of all criteria. The mathematical equation is:

$$d_{kl} = \frac{max\{|v_{kj} - v_{ij}|\}_{j \in D_{kl}}}{max\{|v_{kj} - v_{ij}|\}_{\forall_j}} \quad (2.8)$$

5) Determine the Concordance and Discordance Dominance Matrix

F matrix as the dominant concordance matrix constructed with threshold value, which comparing every concordance matrix element with the threshold value.

$$C_{kl} \geq c \quad (2.9)$$

With the value of threshold (c) is

$$c = \frac{\sum_{k=1}^{m}\sum_{l=1}^{m} c_{kl}}{m(m-1)} \quad (2.10)$$

and the element of *F* matrix determined as:

$$f_{kl} = \begin{cases} 1, if\ c_{kl} \geq c \\ 0, if\ c_{ki} < c \end{cases} \quad (2.11)$$

While the *G* matrix, as the dominant discordance can be constructed using threshold value (d) with equation as

$$d = \frac{\sum_{k=1}^{m}\sum_{l=1}^{m} d_{kl}}{m(m-1)} \quad (2.12)$$

and the element if *G* matrix determined as:

$$g_{kl} = \begin{cases} 1, if\ d_{kl} \geq d \\ 0, if\ d_{ki} < d \end{cases} \quad (2.13)$$

6) Determine the Aggregate Dominance Matrix

Aggregate dominance matrix value is obtained from the multiplication of *F* matrix and *G* matrix. The mathematical equation of aggregate dominance matrix is:

$$e_{kl} = f_{kl} x g_{kl} \quad (2.14)$$

7) Eliminate the Less Favorable Alternatives

The multiplication result of *F* matrix and *G* matrix will be *E* matrix. When the $e_{kl} = 1$, so alternative A_k is a better alternative than A_i. Therefore, the less favorable alternative has the minimum sum in the matrix row.

CHAPTER III
RESEARCH METHODOLOGY

The third chapter of the research explains the methodologies used to conduct this research. The research methodology will be the research guidance in a systematic way. The research methodology will be represented in systematic flowchart.

3.1 Research Methodology

The steps that will conducted in this research will described systematically in this flowchart.

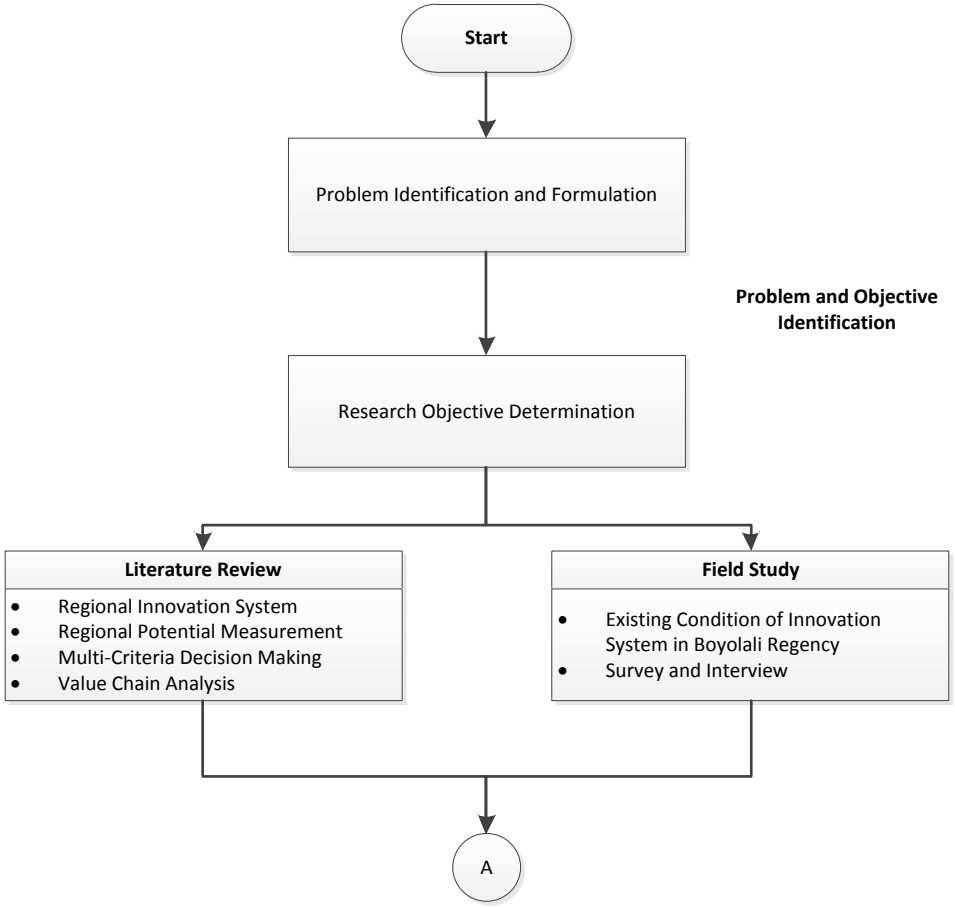

Figure 3. 1 Research Methodology Flowchart

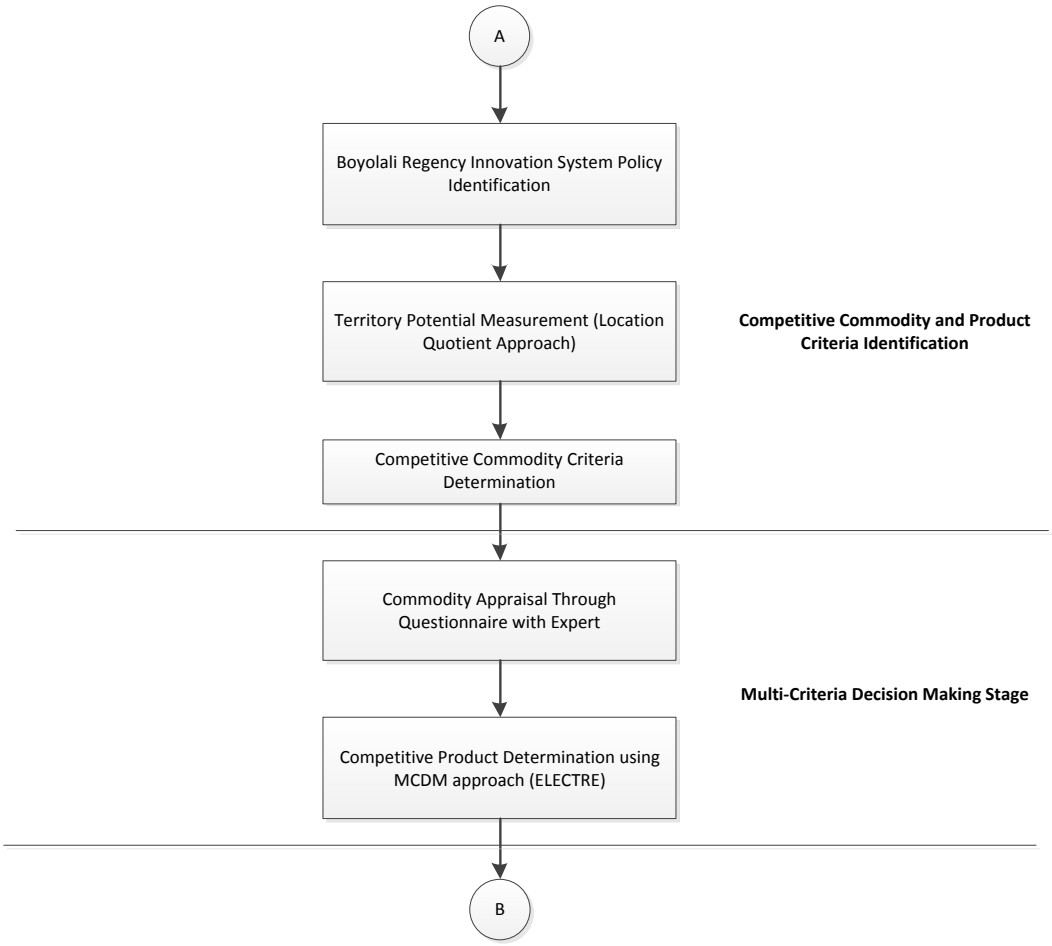

Figure 3. 2 Research Methodology Flowchart (Cont'd)

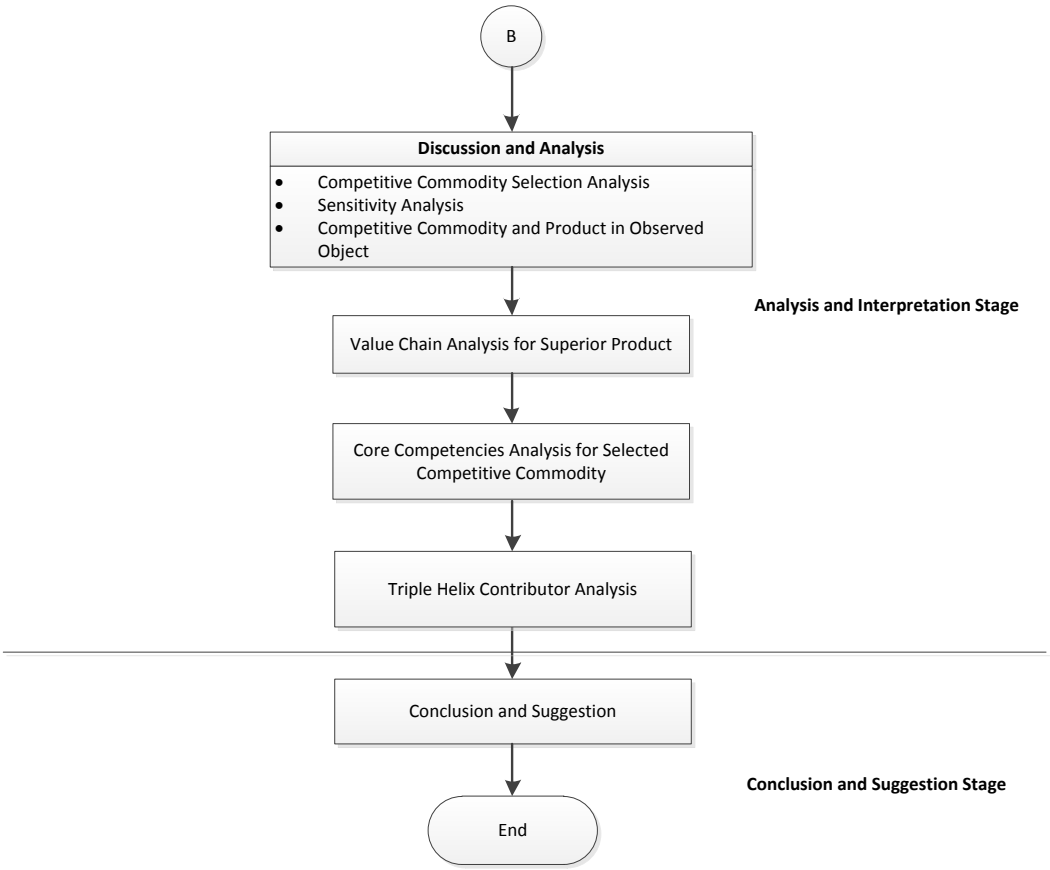

Figure 3. 3 Research Methodology Flowchart (Cont'd)

3.2 Flowchart Description

This subchapter will describe the stages of this research as already pictured in the flowchart above.

3.2.1 Problem and Objective Identification

The problem and objective identification in this research comes from the background of innovation system in Indonesia. The innovation system in Indonesia narrows the system into regional innovation system. Many regional innovation systems did not applicate triple helix system that usually lead to a better innovation system. After the researcher decide the research problem and objective, the researcher need to conduct a literature review and field study in this stage. The literature review is about all the theory and literature needed to conduct the research. The literature reviewed in this stage are regional system, potential measuring, multi-

criteria decision-making, and value chain analysis. While the field study investigates the observed object of this, research which is the existing condition of Boyolali.

3.2.2 Competitive Sector and Product Criteria Identification

This stage of research consists of the identification of existing Boyolali innovation system policy, the potential sector measurement in Boyolali using location quotient method. After the potential sector is determined, the next step is creating the criteria for deciding the competitive commodity of the regency.

3.2.3 Multi-Criteria Decision Making Stage

The initial data of the multi-criteria decision-making stage is the appraisal data of commodity criteria. The data appraisal use questionnaire filled by the expert of regency development. After the criteria appraisal, the researcher will determine the competitive product of the research object based on the data of the questionnaire. The MCDM technique used is ELECTRE method.

3.2.4 Analysis and Interpretation Stage

The analysis and data interpretation stage of this research includes the territorial potential analysis, criteria appraisal comparison and superior product determined using MCDM technique. The competitive commodtiy in the regency will have further analysis using value chain theory. The researcher will have consultation prior to the value chain analysis result of the competitive product.

3.2.5 Conclusion and Suggestion Stage

The conclusion and suggestion from this research are addressed to both the observed object and researcher. The suggestion to the observed object intended to the observed object purposed to improve the innovation system in the observed object. While the suggestion for the researcher purposed to improve the further research about similar topics in the future.

CHAPTER IV
DATA COLLECTION AND PROCESSING

This chapter explains the data collected and data processing during the research. The data collection and processing of this research consist of Boyolali regency profile, location quotient data processing,

4.1 Boyolali Regency Profile

Boyolali as the object of this research will described in this subchapter. The profile of Boyolali Regency will divided into the geographical condition,

4.1.1 Geograpihcal Condition of Boyolali Regency

Boyolali regency located in geographical position of $110^0$22'-$110^0$50' east longitude and $7^0$7' - $7^0$36' south latitude. The geographical position of Boyolali support the regency to creating regency development, which are exactly in the middle of Yogyakarta-Solo-Semarang triangle (Joglosemar) or three of the biggest city in Center-Java province. Concomitant with the development of Solo-Semarang highway and Solo-Ngawi highway, the development of Boyolali will expected to increase rapidly. Boyolali regency administratively divided into 19 districts which can be seen in the map below

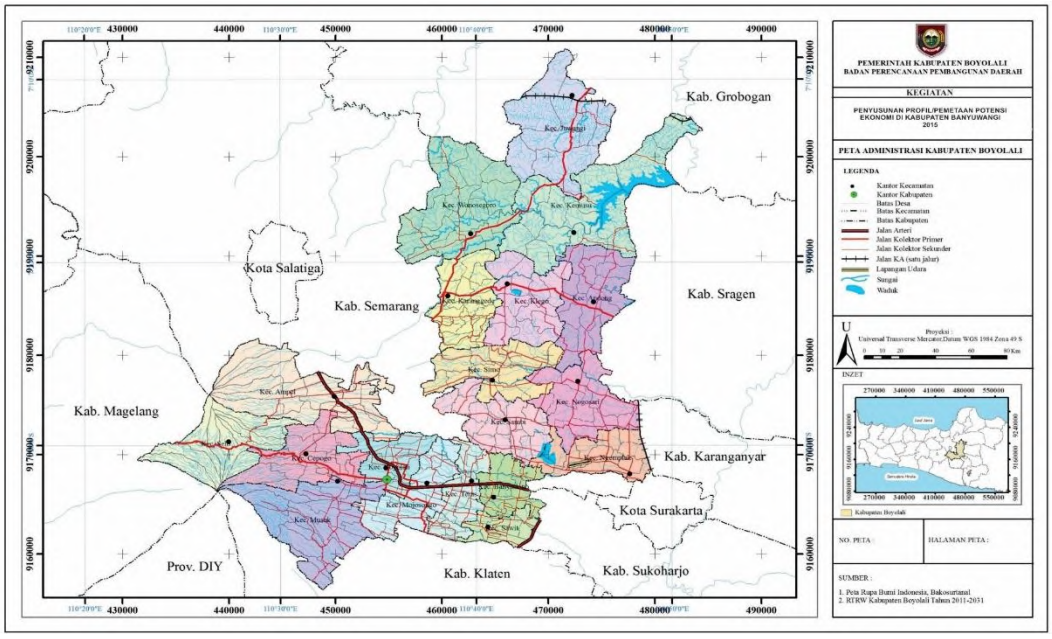

Figure 4. 1 Boyolali Regency Map (Source: Boyolalikab.go.id)

The topographical condition of Boyolali regency were very variative as can be seen in figure 4.1. The classification of topographical condition of Boyolali regency described as below:

1. 75 – 200 meters above sea level: Boyolali, Teras, Mojosongo, Banyudono, Sawit, Nogosari, Karanggede, Ngemplak, Kemusu, Simo, Juwangi, Wonosegoro, Klego, Sambi, and Andong district.
2. 400 – 700 meters above sea level: Musuk, Ampel, Cepogo, and Boyolali district.
3. 700 – 1000 meters above sea level: Musuk, Cepogo, and Ampel district
4. 1000 – 1300 meters above sea level: Selo, Cepongo, and Ampel district
5. 1300 – 1500 meters above sea level: Selo district.

4.1.2 Land Usage and Regional Development

The land usage in Boyolali divided into two types, Rice soil and dry soil. Table 4.1 below will describe the land usage of Boyolali regency.

Table 4. 1 Boyolali Regency Land Usage (Source: Boyolali Dalam Angka, 2015)

Land Usage	Area	Percentage
Dry Soil	78.800,0360	46.93%
Rice Soil		3.02%
Technical Irrigation	5.074,2530	2.89%
Half-Technical Irrigation	4.852,7548	1.59%
Simple Irrigation	2.665,3414	6.03%
Rainfed	10.118,8099	15.05%
Yard / Building	25.271,6192	18.15%
Moor / Garden	30.479,7729	5.86%
Pasture	9,833,315	0.49%
Pond / Pool	8,204,531	46.93%

The development of rural and settlement system in Boyolali directed to the effort to development equalization of the regency and to prevent the discrepancy of the districts. The development strategy of the district based on the geographical condition and influence the the distribution pattern and accessability of the district.

Based on the condition, the spatial planning of Boyolali Regency based on these condition:

1. Select the potential village as the center of development.
2. The development of tour activity that support the integrated agroexcursion, agrobusiness, and agroindustry.
3. The enhancement of human resoruce. The human existance in this regency become the main priority of district development.

Based on the spatial planning of Boyolali Regency, the development region in Boyolali Regency planned as below

1. Development Center Region
    a. Development center: Ampel, Teras, Banyudono, Sambi, Ngemplak, Simo, and Karanggede
    b. Potential development as trading region: Cepongo, Musuk, Nogosari, Andong, Kemusu Wonosegoro and Juwangi.
2. Economic Development Region
    a. Industrial zone: Ampel, Cepongo, Musuk, Boyolali, Mojosongo, Teras, Sawit, Banyudono, Sambi, Ngemplak, Nogosari, Simo, Klego, Andong, Kemusu, Wonosegoro and Juwangi district.
3. Tourism Region
    a. Tourism development zone: Selo, Ampel, Cepogo, Musuk, Boyolali, Mojosongo, Teras, Sawit, Banyudono, Sambi, Ngemplak, Simo, Klego, and Kemusu district.

4.2 Competitive Commodity Alternatives Data Processing

Before the selection of competitive product in Boyolali Regency using Multi-Criteria Decision Making method, the alternatives of the product or commodity will determined from all commodity produce by the regency using Location Quotient method. The commodity that has Location Quotient value bigger than one considered as potential commodity in the regency. In this research, the number of alternatives will come from different sub-sector and the maximum of

commodity from the same sub-sector is two commodity. Also of one commodity is much superior in LQ value than the others in the sub-sector, it will be the only alternatives come from the subsector. The data of production obtained from Boyolali Dalam Angka 2015 and Jawa Tengah Dalam Angka 2015. Table 4.2 until table 4.8 shows the calculation of Location Quotient value for each sub-sector.

Table 4. 2 Agriculture Sub-Sector LQ Calculation (Source: BDA 2015, JATENG DA 2015)

	Boyolali	Central-Java	LQ
Agriculture (Tons)	505,808.00	14,685,254.00	
Lowland Rice	246,681.00	9,294,475.00	0.77056
Highland Rice	19,809.00	353,630.00	1.626332
Corn	136,434.00	3,051,516.00	1.298084
Cassava	94,322.00	3,977,810.00	0.688438

The calculation example for Location Quotient method is as follows

$$Highland\ Rice\ LQ = \frac{\frac{Boyolali\ Highland\ Rice\ Production}{Center\ Java\ Highland\ Production}}{\frac{Boyolali\ Agriculture\ Production}{Center\ Java\ Agriculture\ Production}}$$

$$= \frac{\frac{19{,}809}{353{,}630}}{\frac{505{,}808}{14{,}685{,}254}} = 1.626332$$

In agriculture sub-sector in Boyolali, the regency produce four type of commodity, which are lowland rice, highland rice, corn, and cassava. From the calculation of Location Quotient in this sub-sector, select highland rice and corn as the alternatives of competitive product in the regency from agriculture sub-sector. In this occasion, highland rice commodity have the biggest production in the sub-sector. However, the number of production of this commodity in other region is bigger than in Boyolali. In several cases similar to this, the commodity will not able to become the featured competitive product in the region. Nevertheless, it is potential for the regency to be a support of other region and have a mutualism relation with other regency.

Table 4. 3 Vegetables Sub-Sector LQ Calculation (Source: BDA 2015, JATENG DA 2015)

	Boyolali	Central-Java	LQ
Vegetables (Quintal)	1,439,023.00	16,458,208.00	
Chili	308,512.00	2,757,469.00	1.279606
Mustard	66,806.00	804,908.00	0.949257
Cabbage	150,208.00	3,583,428.00	0.479412
Carrot	139,519.00	1,427,310.00	1.117969
Chayote	114,828.00	692,007.00	1.897807

From the calculation of LQ in vegetables sub-sector in table 4.3. The alternatives as featured competitive product in Boyolali is chili and chayote commodity. Carrot also have location quotient value bigger than one. However, since only two selected in order to make the multi-criteria calculation process able, carrot not considered as the alternatives of featured competitive product in Boyolali regency.

Table 4. 4 Fruits Sub-sector LQ Calculation (Source: BDA 2015, JATENG DA 2015)

	Boyolali	Central-Java	LQ
Fruits (Quintal)	973,301.00	23,548,739.00	
Avocado	75,429.00	332,273.00	5.492421
Banana	350,621.00	5,196,281.00	1.632547
Durian	19,731.00	1,011,673.00	0.471878
Papaya	268,043.00	1,056,240.00	6.139915
Mango	158,691.00	4,596,691.00	0.835271

In Location Quotient calculation in fruits sub-sector in table 4.4, the LQ value of avocado and papaya is much superior to other commodity in the fruits sub-sector. Therefore, the featured competitive product from fruits sub-sector is avocado and papaya.

Table 4. 5 Plantation Sub-Sector LQ Calculation (Source: BDA 2015, JATENG DA 2015)

	Boyolali	Central-Java	LQ
Plantation (Quintal)	544,690.00	1,358,441.00	
Coconut	10,835.20	186,958.00	0.144539
Clove	1,897.00	8,214.00	0.575976
Sand Ginger	22,144.00	10,100.00	5.467969
Ginger	10,385.00	42,363.00	0.61138
Robusta Coffee	179.00	20,694.00	0.021572

In Location Quotient in plantation sub-sector, the only commodity that has good LQ value is sand ginger commodity and it it superior to other commodity in plantation sub-sector. Therefore, the only alternative from plantation sub-sector is sand ginger commodity.

Table 4. 6 Livestock Sub-Sector LQ Calculation (Source: BDA 2015, JATENG DA 2015)

	Boyolali	Central-Java	LQ
Livestock (Head)	342,121.00	8,285,609.00	
Butchery Cattle (Cows)	80,092.00	1,592,638.00	1.217914
Dairy Cattle (Cows)	77,805.00	122,566.00	15.37383
Goat	35,578.00	3,957,917.00	0.217701
Sheep	53,872.00	2,395,671.00	0.544604
Pig	3,249.00	136,495.00	0.576471
Bird Livestock (Head)	4,445,301.00	178,893,208.00	
Egg Laying Chicken	1,038,513.00	23,293,547.00	1.794192
Buthcery Chicken	1,460,420.00	108,195,894.00	0.5432
Quail Bird	1,080,968.00	3,995,114.00	10.88871

In Location Quotient calculation of livestock sub-sector as table 4.6. The sub-sector divided into two, which are dairy cattle livestock and bird livestock. Dairy cattle commodity is much superior to other commodity in the livestock sub-sector. That means only dairy cattle livestock as the alternatives from livestock sub-sector. While in bird livestock, quail bird livestock also dominant in the sub-sector. Therefore, the only alternatives come from bird livestock sub-sector is quail bird livestock.

Table 4. 7 Eggs Sub-Sector LQ Calculation (Source: BDA 2015, JATENG DA 2015)

	Boyolali	Central-Java	LQ
Eggs (Kgs)	15,303,757.00	270,578,394.00	
Chicken Egg	10,236,616.00	191,545,667.00	0.944885
Duck Egg	2,181,595.00	45,704,503.00	0.843937
Quail Egg	2,054,817.00	7,307,316.00	4.971762

In calculation of eggs sub-sector Location Quotient in table 4.7, the biggest LQ value is quail eggs. Therefore, the only alternatives from eggs sub-sector is quail bird eggs.

Table 4. 8 Meat and Milk Sub-Sector LQ Calculation (Source: BDA 2015, JATENG DA 2015)

	Boyolali	Central-Java	LQ
Meat and Milk (Kgs/ Litre)			
Beef	9,902,400.00	55,987,954.00	0.421428
Lamb	106,184.00	11,173,718.00	0.022643
Cow's Milk	64,272,511.00	98,493,787.00	1.55487

In calculation of meat and milk sub-sector, the biggest LQ value is from cow's milk. Therefore, the only alternatives from meat and milk sub-sector is cow's milk.

In industrial processing sector, the alternatives selected from the employment and investment in the industry. The data will provided in the table below

Table 4. 9 Industrial Processing Employment and Investment (Source: BDA, 2015)

	Indusry Type	Unit	Employement	Investment (000 Rp)
A.	**Agro Industry**			
1	Meat Based Food Industry	13	136	510.820.000
2	Milk Based Food Indusrty	2	11	24.000.000
3	Paddy & Flour Based Indusrty	4	18	170.000.000
4	Drink Industry	43	71	133.900.000
5	Tobbaco Industry	153	3.469	16.144.700.000
B.	**Chemical and Forestry Industry**			
1	Sawmill and Preservation Industry	24	143	1.033.000.000
2	Wood based Goods and Webbing Industry	533	943	1.543.572.000
3	Publishing Indusrty	31	58	185.250.000
4	Chemical and Other Industry	13	140	540.100.000
5	Clay Industry	76	218	374.995.000
6	Cement Industry	157	416	1.500.737.000
7	Furniture Industry	585	2.513	19.103.240.000
8	Stone Based Indusrty	9	32	159.000.000
C.	**Metal Based Industry**			
1	Metal goods for Consturction Industry	6	15	64.500.000
2	Metal goods Industry	519	1.703	5.060.750.000
3	Metal Equipment for Agriculture Industry	75	1.123	4.180.950.000
D.	**Electronic Industry**	13	97	565.000.000
1	Clothing Industry	8	26	188.000.000
2	Footwear Industry	9	36	185.500.000
3	Shoes Industry	34	103	222.800.000
4	Other Industry	14	295	960.000.000

From the data of industrial processing industry listed in table 4.9, four commodity have advantages from other commodity in terms of employment and investment, which are tobacco industry, wood based goods and webbing industry,

furniture industry, and metal goods industry. After all the calculation of Location Quotient for all commodity, the recapitulation of alternatives of featured competitive product listed on the table 4.10 below.

Table 4. 10 Competitive Commodity Alternative Recapitulation

Commodity	Boyolali (Production)	Center-Java (Production	LQ
Highland Rice (Tons)	19,809.00	353,630.00	1.626
Corn (Tons)	136,434.00	3,051,516.00	1.298
Chili (Quintal)	308,512.00	2,757,469.00	1.280
Chayote (Quintal)	114,828.00	692,007.00	1.898
Avocado (Quintal)	75,429.00	332,273.00	5.492
Papaya (Quintal)	268,043.00	1,056,240.00	6.140
Sand Ginger (Quintal)	22,144.00	10,100.00	5.468
Dairy Cows (Head)	77,805.00	122,566.00	15.374
Quail Bird (Head)	1,080,968.00	3,995,114.00	10.889
Quail Egg (Kgs)	2,054,817.00	7,307,316.00	4.972
Cow's Milk (Litres)	64,272,511.00	98,493,787.00	1.555
Commodity	Industry Unit Number	Employement	Total Investment
Tobbaco Industry	153	3.469	16.144.700.000
Wood based Goods and Webbing Industry	533	943	1.543.572.000
Furniture Industry	585	2.513	19.103.240.000
Metal goods Industry	519	1.703	5.060.750.000

4.3 Competitive Product Criteria Weighing

The implementation of criteria weighing will become the initial process of the multi-criteria decision-making. The data collected from the questionnaire spread to the expertise in this research sector will used as the criteria weighing data.

4.3.1 Criteria Weighing Data Collection Expertise

The questionnaire spread to several organization in Boyolali Regency. The organization are *Badan Perencanaan dan Pembangunan Daerah (*BAPPEDA), *Dinas Pertanian Perhutananan dan Perkebunan* (DISTANBUNHUT), and *Dinas Perindustrian dan Perdagangan* (DISPERINDAG). Table 4.11 will contain the expert identity and organization who filled the questionnaire.

Table 4. 11 Boyolali Expertise in Regency Development

No	Name	Organization	Position
1	Gunawan A.	Bappeda	Agriculture Sub-Field Head
2	Sarangat, SH	Bappeda	Economy Field Head
3	Fiktor M. P.	Bappeda	Staff
4	Sasongko P.	Distanbunhut	Land use, Water, and Infrastructure Manager
5	Ibnu Sutopo	Distanbunhut	Agriculture Inftrasturcutre Head
6	Satriyo W.	Distanbunhut	Rice Production Head
7	Sriharyanti	Distanbunhut	Horticulture Production Head
8	Sri Haryono	Disperindag	Service Secretary
9	Agus Supriyadi	Disperindag	Industrial Field Head
10	Sri Handayani	Disperindag	Information and Promotion Head

From table 4.11, the number of questionnaire sprad to the expertise is 10. In Multi-Criteria Decision-Making, the number of weighing data is considered enough as long the questionnaire data received from the expert who is fully understand about the topic. In this research, the 10 expertise from the organization in Boyolali regency considered understand enough about competitive product in the regency and have a subjective perspective for all the commodities in Boyolali.

4.3.2 Competitive Commodity Criteria Weighing using PROMAX Software

The competitive product criteria weighted based on the questionnaire spread to the expertise. The weighting scoring is using pairwise type as already mentioned before in chapter 2. In PROMAX software, the software already provide the pairwise scoring method. By using AHP method, the software will automatically determine the weight based on the scoring in questionnaire. Table 4.12 until Table 4.14 will contain the result and recapitulation of criteria weighing using PROMAX software. The detailed weighing using PROMAX software is also provided in the attachment section in the end of this report.

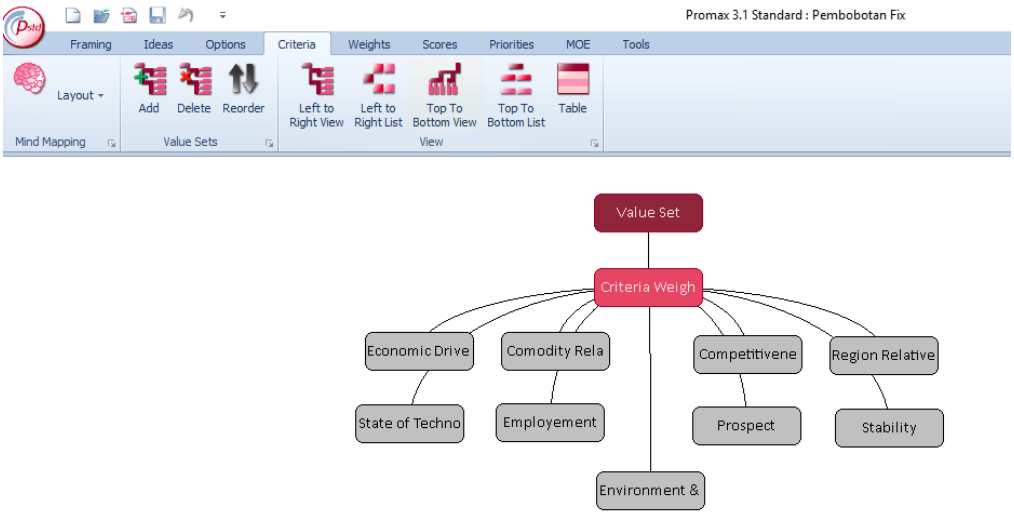

Figure 4. 2 Competittive Commodity Criteria Hierarchy

Table 4. 12 Payoff MCDM Matrice based on Criteria Scoring (1)

No	Name	Organization	Position	Criteria		
				Economy Driver	Other Comodity Relativeness	Competitiveness
1	Gunawan A.	Bappeda	Agriculture Sub-Field Head	17	14	9
2	Sarangat, SH	Bappeda	Economy Field Head	7	8	16
3	Fiktor M. P.	Bappeda	Staff	8	8	14

Table 4. 13 Payoff MCDM Matrice based on Criteria Scoring (1) (Cont)

No	Name	Organization	Position	Criteria		
				Economy Driver	Other Comodity Relativeness	Competitiveness
5	Ibnu Sutopo	Distanbunhut	Agriculture Inftrasturcutre Head	14	9	10
6	Satriyo W.	Distanbunhut	Rice Production Head	15	8	16
7	Sriharyanti	Distanbunhut	Horticulture Production Head	12	8	15
8	Sri Haryono	Disperindag	Service Secretary	20	20	6
9	Agus Supriyadi	Disperindag	Industrial Field Head	23	13	13
10	Sri Handayani	Disperindag	Information and Promotion Head	17	20	9
Average				14.7	11.9	12.3

Table 4. 14 Payoff MCDM Matrice based on Criteria Scoring (2)

No	Name	Organization	Position	Criteria		
				Other Region Relativeness	State of Technology	Employement
1	Gunawan A.	Bappeda	Agriculture Sub-Field Head	3	3	30
2	Sarangat, SH	Bappeda	Economy Field Head	7	10	15
3	Fiktor M. P.	Bappeda	Staff	6	10	12
4	Sasongko P.	Distanbunhut	Land use, Water, and Infrastructure Manager	3	3	14
5	Ibnu Sutopo	Distanbunhut	Agriculture Inftrasturcutre Head	7	12	18

Table 4. 15 Payoff MCDM Matrice based on Criteria Scoring (2) (Cont)

No	Name	Organization	Position	Criteria		
				Other Region Relativeness	State of Technology	Employement
7	Sriharyanti	Distanbunhut	Horticulture Production Head	11	12	12
8	Sri Haryono	Disperindag	Service Secretary	13	10	13
9	Agus Supriyadi	Disperindag	Industrial Field Head	5	5	17
10	Sri Handayani	Disperindag	Information and Promotion Head	12	7	10
Average				7.2	7.6	14.8

Table 4. 16 Payoff MCDM Matrice based on Criteria Scoring (3)

No	Name	Organization	Position	Criteria		
				Comodity Prospect	Stability to Fluctiation	Environment & Culture Support
1	Gunawan A.	Bappeda	Agriculture Sub-Field Head	13	4	7
2	Sarangat, SH	Bappeda	Economy Field Head	17	12	8
3	Fiktor M. P.	Bappeda	Staff	20	15	7
4	Sasongko P.	Distanbunhut	Land use, Water, and Infrastructure Manager	18	14	8
5	Ibnu Sutopo	Distanbunhut	Agriculture Inftrasturcutre Head	10	8	12
6	Satriyo W.	Distanbunhut	Rice Production Head	22	7	16
7	Sriharyanti	Distanbunhut	Horticulture Production Head	16	8	6
8	Sri Haryono	Disperindag	Service Secretary	6	6	6
9	Agus Supriyadi	Disperindag	Industrial Field Head	6	8	10
10	Sri Handayani	Disperindag	Information and Promotion Head	9	8	8
Average				13.7	9	8.8

From the tables above. The criteria weighting result is the average of all the expertise weighing. The total of weight of all criteria is 100. So the criteria weighting also equal to criteria weight percentage. The criteria weighting later will used as the input to determine the featured competitive product in Boyolali regency.

4.4 Competitive Commodity Determination using ELECTRE Method

The competitive product of Boyolali Regency is determined using one of Multi-Criteria Decision-Making, which is ELECTRE method. There are 7 steps to perform ELECTRE method to decide the best alternatives based on the criteria. Beside the criteria that already weighted, the input of ELECTRE method also the

scoring of the alternatives by the same expert before. The recapitulation of alternatives scoring by the expertise will described in table 4.14 to table 4.16 below.

Table 4. 17 Multi Criteria Alternatives Appraisal (1)

Criteria / Commodity	Economy Driver	Other Comodity Relativeness	Competitiveness
Highland Rice	4.6	3.7	3.7
Corn	4.1	3.6	3.8
Chili	3.9	3.7	3.5
Chayote	3.2	3.1	3.1
Avocado	3.5	3.3	3.3
Papaya	3.9	3.3	3.4
Sand Ginger	3.9	3.3	3.3
Diary Cattle	4.6	3.8	3.8
Quail Bird	3.1	2.9	3
Quail Bird Egg	3.4	3	3.1
Cow's Milk	4.6	3.7	4
Tobacco Industry	4.2	3.6	3.5
Wood Goods & Webbing Industry	3.6	3.4	3.4
Furniture Industry	3.9	4.1	3.7
Metal Goods Industry	4.2	3.5	3.8

Table 4. 18 Multi Criteria Alternatives Appraisal (2)

Criteria / Commodity	Other Region Relativeness	State of Technology	Employement
Highland Rice	3.4	3.4	3.9
Corn	3.5	3.1	3.7
Chili	3.4	2.8	3.6
Chayote	2.7	2.6	3
Avocado	3	2.5	2.6
Papaya	3.2	3.5	3.7
Kencur	3.3	3.4	3.5
Diary Cattle	4	3.5	4.3
Quail Bird	2.8	3	2.9
Quail Bird Egg	2.9	2.8	2.8
Cow's Milk	3.7	3.7	3.8

Criteria / Commodity	Other Region Relativeness	State of Technology	Employement
Tobacco Industry	3.5	3.5	4
Wood Goods & Webbing Industry	3.4	3.4	3.8
Furniture Industry	3.7	4.3	4.2
Metal Goods Industry	3.7	4.4	4

Table 4. 19 Multi Criteria Alternatives Appraisal (3)

Criteria / Commodity	Comodity Prospect	Stability to Fluctiation	Environment & Culture Support
Highland Rice	4.2	3.2	4.2
Corn	3.8	2.9	3.9
Chili	4	2.5	3.4
Chayote	3.5	2.6	3
Avocado	3.5	2.6	3
Papaya	3.9	3.3	3.9
Kencur	3.9	3.4	3.8
Diary Cattle	4.4	3.8	4.2
Quail Bird	3	2.6	2.9
Quail Bird Egg	3.3	2.5	3
Cow's Milk	4.4	3.2	3.8
Tobacco Industry	3.9	2.9	3.6
Wood Goods & Webbing Industry	3.5	3.4	3.7
Furniture Industry	4.1	3.6	3.8
Metal Goods Industry	3.8	3.6	3.6

The scoring value of each commodity to criteria obtained from the average scoring from the expertise. The scoring of the alternatives is in range from 1 to 5. 1 is bad score for the criteria and 5 is the good score for the criteria.

4.4.1 Decision Matrix Normalizing

In ELECTRE Method, the scoring table that already discussed previously is also known as decision matrix. The scoring table will transformed into decision matrix as below

Table 4. 20 Decision Matrix

4.6	3.7	3.7	3.4	3.4	3.9	4.2	3.2	4.2
4.1	3.6	3.8	3.5	3.1	3.7	3.8	2.9	3.9
3.9	3.7	3.5	3.4	2.8	3.6	4	2.5	3.4
3.2	3.1	3.1	2.7	2.6	3	3.5	2.6	3
3.5	3.3	3.3	3	2.5	2.6	3.5	2.6	3
3.9	3.3	3.4	3.2	3.5	3.7	3.9	3.3	3.9
3.9	3.3	3.3	3.3	3.4	3.5	3.9	3.4	3.8
4.6	3.8	3.8	4	3.5	4.3	4.4	3.8	4.2
3.1	2.9	3	2.8	3	2.9	3	2.6	2.9
3.4	3	3.1	2.9	2.8	2.8	3.3	2.5	3
4.6	3.7	4	3.7	3.7	3.8	4.4	3.2	3.8
4.2	3.6	3.5	3.5	3.5	4	3.9	2.9	3.6
3.6	3.4	3.4	3.4	3.4	3.8	3.5	3.4	3.7
3.9	4.1	3.7	3.7	4.3	4.2	4.1	3.6	3.8
4.2	3.5	3.8	3.7	4.4	4	3.8	3.6	3.6

The normalization of decision matrix using the equation below

$$r_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{m} x_{ij}^2}} \; for \; i = 1,2,3,..,m \; and \; j = 1,2,3,..,n \qquad (4.1)$$

and the result of the normalized matrix is shown below

Table 4. 21 Normalized Decision Matrix

0.3013	0.2745	0.2725	0.2608	0.2606	0.2780	0.2830	0.2663	0.3003
0.2686	0.2670	0.2799	0.2685	0.2376	0.2637	0.2560	0.2413	0.2789
0.2555	0.2745	0.2578	0.2608	0.2146	0.2566	0.2695	0.2080	0.2431
0.2096	0.2300	0.2283	0.2071	0.1993	0.2138	0.2358	0.2163	0.2145
0.2293	0.2448	0.2431	0.2301	0.1916	0.1853	0.2358	0.2163	0.2145
0.2555	0.2448	0.2504	0.2455	0.2682	0.2637	0.2627	0.2746	0.2789
0.2555	0.2448	0.2431	0.2532	0.2606	0.2495	0.2627	0.2829	0.2717
0.3013	0.2819	0.2799	0.3069	0.2682	0.3065	0.2964	0.3162	0.3003
0.2031	0.2151	0.2210	0.2148	0.2299	0.2067	0.2021	0.2163	0.2074
0.2227	0.2225	0.2283	0.2225	0.2146	0.1996	0.2223	0.2080	0.2145
0.3013	0.2745	0.2946	0.2838	0.2836	0.2709	0.2964	0.2663	0.2717
0.2751	0.2670	0.2578	0.2685	0.2682	0.2851	0.2627	0.2413	0.2574
0.2358	0.2522	0.2504	0.2608	0.2606	0.2709	0.2358	0.2829	0.2646

0.2555	0.3041	0.2725	0.2838	0.3295	0.2994	0.2762	0.2995	0.2717
0.2751	0.2596	0.2799	0.2838	0.3372	0.2851	0.2560	0.2995	0.2574

4.4.2 Normalized Decision Matrix Weighting

The normalized decision matrix need to be weighted using the criteria weight that already constructed before. The weighting of normalized decision matrix is using the equation

$$V = R\ x\ W \tag{4.2}$$

The criteria weight matrix is show as

W =

Table 4. 22 Critera Weight Matrix

14.7	0	0	0	0	0	0	0	0
0	11.9	0	0	0	0	0	0	0
0	0	12.3	0	0	0	0	0	0
0	0	0	7.2	0	0	0	0	0
0	0	0	0	7.6	0	0	0	0
0	0	0	0	0	14.8	0	0	0
0	0	0	0	0	0	13.7	0	0
0	0	0	0	0	0	0	9	0
0	0	0	0	0	0	0	0	8.8

and the result of normalized decision matrix weighting is

V =

Table 4. 23 Weighted Normalized Decision Matrix

4.43	3.2661	3.352	1.878	1.98	4.114	3.877	2.396	2.643
3.948	3.1778	3.443	1.933	1.806	3.903	3.507	2.172	2.454
3.756	3.2661	3.171	1.878	1.631	3.798	3.692	1.872	2.139
3.081	2.7364	2.809	1.491	1.514	3.165	3.23	1.947	1.888
3.37	2.913	2.99	1.657	1.456	2.743	3.23	1.947	1.888
3.756	2.913	3.08	1.768	2.039	3.903	3.6	2.471	2.454
3.756	2.913	2.99	1.823	1.98	3.692	3.6	2.546	2.391
4.43	3.3543	3.443	2.209	2.039	4.536	4.061	2.846	2.643
2.985	2.5599	2.718	1.547	1.747	3.059	2.769	1.947	1.825
3.274	2.6482	2.809	1.602	1.631	2.954	3.046	1.872	1.888
4.43	3.2661	3.624	2.044	2.155	4.009	4.061	2.396	2.391
4.044	3.1778	3.171	1.933	2.039	4.22	3.6	2.172	2.265

3.467	3.0012	3.08	1.878	1.98	4.009	3.23	2.546	2.328
3.756	3.6191	3.352	2.044	2.504	4.431	3.784	2.696	2.391
4.044	3.0895	3.443	2.044	2.563	4.22	3.507	2.696	2.265

4.4.3 Concordance and Discordance Sets Determining

The concordance and discordance sets obtained from the set C_{kl} of two alternatives. The concordance sets is obtained using equation below.

$$C_{kl} = \{j, v_{kl} \geq v_{ij}\}, for\ j = 1,2,3, \dots ,9 \quad (4.3)$$

The determination of discordance set for each alternative, the discordance sets is determined using the equation,

$$D_{kl} = \{j, v_{kl} < v_{ij}\}, for\ j = 1,2,3, \dots , n \quad (4.4)$$

The recapitulation concordance and discordance sets is shown in the table below

Table 4. 24 Concordance Sets Recapitulation

Ck \ Cl	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	-	1,2,5,6,7,8,9	1,2,3,4,5,6,7,8,9	1,2,3,4,5,6,7,8,9	1,2,3,4,5,6,7,8,9	1,2,3,6,7,9	1,2,3,4,5,6,7,9	1,9	1,2,3,4,5,6,7,8,9	1,2,3,4,5,6,7,8,9	1,2,6,8,9	1,2,3,7,8,9	1,2,3,4,5,6,7,9	1,3,7,9	1,2,7,9
2	3,4	-	1,3,4,5,6,8,9	1,2,3,4,5,6,7,9	1,2,3,4,5,6,7,9	1,2,3,4,6,9	1,2,3,4,6,9	3	1,2,3,4,5,6,7,9	1,2,3,4,5,6,7,9	9	2,3,4,8,9	1,2,3,4,7,9	1,3,9	2,3,7,9
3	2,4	2,7	-	1,2,3,4,5,6,7,9	1,2,3,4,5,6,7,9	1,2,3,4,7	1,2,3,4,6,7	-	1,2,3,4,6,7,9	1,2,3,4,5,6,7,8,9	2	2,3,7	1,2,3,4,7	1	2,7
4	-	-	8	-	1,2,3,4,5,6,7,8,9	-	-	-	1,2,3,6,7,8,9	2,3,6,7,8,9	-	-	7	-	-
5	-	-	8	1,2,3,4,7,8,9	-	2	2,3	-	1,2,3,4,7,8,9	1,2,3,4,7,8,9	-	-	7	-	-
6	5,8	5,6,7,8,9	1,5,6,8,9	1,2,3,4,5,6,7,8,9	1,2,3,4,5,6,7,8,9	-	1,2,3,5,6,7,9	5	1,2,3,4,5,6,7,8,9	1,2,3,4,5,6,7,8,9	8,9	5,7,8,9	1,3,5,7,9	1,9	7,9
7	5,8	5,7,8	1,5,8,9	1,2,3,4,5,6,7,8,9	1,2,3,4,5,6,7,8,9	1,2,4,7,8	-	-	1,2,3,4,5,6,7,8,9	1,2,3,4,5,6,7,8,9	8,9	7,8,9	1,5,7,8,9	1,9	7,9
8	1,2,3,4,5,6,7,8,9	1,2,3,4,5,6,7,8,9	1,2,3,4,5,6,7,8,9	1,2,3,4,5,6,7,8,9	1,2,3,4,5,6,7,8,9	1,2,3,4,5,6,7,8,9	1,2,3,4,5,6,7,8,9	-	1,2,3,4,5,6,7,8,9	1,2,3,4,5,6,7,8,9	1,2,4,6,7,8,9	1,2,3,4,5,6,7,8,9	1,2,3,4,5,6,7,8,9	1,3,4,6,7,8,9	1,2,3,4,6,7,8,9
9	-	-	5,8	4,5,8	5,6,8	-	-	-	-	5,6,8	-	-	-	-	-
10	-	-	5,8	1,3,4,5,8,9	5,6,9	-	-	-	1,2,3,4,7,9	-	-	-	-	-	-
11	1,2,3,4,5,7,8	1,2,3,4,5,6,7,8	1,2,3,4,5,6,7,8,9	1,2,3,4,5,6,7,8,9	1,2,3,4,5,6,7,8,9	1,2,3,4,5,6,7	1,2,3,4,5,6,8,9	1,3,5,7	1,2,3,4,5,6,7,8	1,2,3,4,5,6,7,8	-	1,2,3,4,5,6,7,8,9	1,2,3,4,5,6,7,9	1,3,4,7,9	1,2,3,4,7,9
12	4,5,6	1,2,4,5,6,7,8	1,2,3,5,6,8,9	1,2,3,4,5,6,7,8,9	1,2,3,4,5,6,7,8,9	1,2,3,4,5,6,7	1,2,3,4,5,6,7	5	1,2,3,4,5,6,7,8,9	1,2,3,4,5,6,7,8,9	6	-	1,2,3,4,5,6,7	1	1,2,6,7,9
13	4,5,8	5,6,8	4,5,6,8	1,2,3,4,5,6,7,8,9	1,2,3,4,5,6,7,8,8	2,3,4,6,8	2,3,4,5,6,8	-	1,2,3,4,5,6,7,8,9	1,2,3,4,5,6,7,8,9	6,8	8,9	-	-	9
14	2,3,4,5,6,8	2,4,5,6,7,8	1,2,3,4,5,6,7,8,9	1,2,3,4,5,6,7,8,9	1,2,3,4,5,6,7,8,9	1,2,3,4,5,6,7,8	1,2,3,4,5,6,7,8,9	2,5	1,2,3,4,5,6,7,8,9	1,2,3,4,5,6,7,8,9	2,4,5,6,8,9	2,3,4,5,6,7,8,9	1,2,3,4,5,6,7,8,9	-	2,4,6,7,8,9
15	3,4,5,6,8	1,3,4,5,6,7,8	1,3,4,5,6,7,8	1,2,3,4,5,6,7,8,9	1,2,3,4,5,6,7,8,9	1,2,3,4,5,6,8	1,2,3,4,5,6,8	3,5	1,2,3,4,5,6,7,8,9	1,2,3,4,5,6,7,8,9	4,5,6,8	1,3,4,5,6,8	1,2,3,4,5,6,7,8	1,3,4,5,8	-

Table 4. 25 Discordance Sets Recapitulation

Ck \ Cl	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	-	3,4	-	-	-	5,8	8	2,3,4,5,6,7,8	-	-	3,4,5,7	4,5,6	8	2,4,5,6,8	3,4,5,6,8
2	1,2,5,6,7,8,9	-	2,7	-	-	5,7,8	5,7,8	1,2,4,5,6,7,8,9	-	-	1,2,3,4,5,6,7,8	1,5,6,7	5,6,8	2,4,5,6,7,8	1,4,5,6,8
3	1,3,5,6,7,8,9	1,3,4,5,6,8,9	-	8	8	5,6,8,9	5,8,9	1,2,3,4,5,6,7,8,9	5,8	-	1,3,4,5,6,7,8,9	1,4,5,6,8,9	5,6,8,9	2,3,4,5,6,7,8,9	1,3,4,5,6,8,9
4	1,3,4,5,6,8,9	1,2,3,4,5,6,7,8,9	1,2,3,4,5,6,7,9	-	1,2,3,4	1,2,3,4,5,6,7,8,9	1,2,3,4,5,6,7,8,9	1,2,3,4,5,6,7,8,9	4,5	1,4,5	1,2,3,4,5,6,7,8,9	1,2,3,4,5,6,7,8,9	1,2,3,4,5,6,8,9	1,2,3,4,5,6,7,8,9	1,2,3,4,5,6,7,8,9
5	1,2,3,4,5,6,7,8,9	1,2,3,4,5,6,7,8,10	1,2,3,4,5,6,7,9	5,6	-	1,2,3,4,5,6,7,8,9	1,4,5,6,7,8,9	1,2,3,4,5,6,7,8,9	5,6	5,6	1,2,3,4,5,6,7,8,9	1,2,3,4,5,6,7,8,9	1,2,3,4,5,6,8,9	1,2,3,4,5,6,7,8,9	1,2,3,4,5,6,7,8,9
6	1,2,3,4,6,7,9	1,2,3,4	2,3,4,7	-	-	-	4,8	1,2,3,4,6,7,8,9	-	-	1,2,3,4,5,6,7	1,2,3,4,6	2,4,6,8	2,3,4,5,6,7	1,2,3,4,5,6,8
7	1,2,3,4,6,7,9	1,2,3,4,6,9	2,3,4,6,7	-	-	3,5,6,9	-	1,2,3,4,5,6,7,8,9	-	-	1,2,3,4,5,6,7	1,2,3,4,5,6	2,3,4,6	2,3,4,5,6,7,8	1,2,3,4,5,6,8
8	-	-	-	-	-	-	-	-	-	-	3,5	-	-	2,5	5
9	1,2,3,4,5,6,7,8,9	1,2,3,4,5,6,7,8,9	1,2,3,4,6,7,9	1,2,3,6,7,9	1,2,3,4,7,9	1,2,3,4,5,6,7,8,9	1,2,3,4,5,6,7,8,9	1,2,3,4,5,6,7,8,9	-	1,2,3,4,7,9	1,2,3,4,5,6,7,8,9	1,2,3,4,5,6,7,8,9	1,2,3,4,5,6,7,8,9	1,2,3,4,5,6,7,8,9	1,2,3,4,5,6,7,8,9
10	1,2,3,4,5,6,7,8,9	1,2,3,4,6,7,9	1,2,3,4,6,7,9	2,6,7,8	1,2,3,4,7,8	1,2,3,4,5,6,7,8,9	1,2,3,4,5,6,7,8,9	1,2,3,4,5,6,7,8,9	5,6,8	-	1,2,3,4,5,6,7,8,9	1,2,3,4,5,6,7,8,9	1,2,3,4,5,6,7,8,9	1,2,3,4,5,6,7,8,9	1,2,3,4,5,6,7,8,9
11	-	-	-	-	-	8,9	8	2,4,6,8,9	-	-	-	6	8	2,5,6,8	5,6,8
12	1,2,3,7,8,9	3,9	2,7	-	-	8,9	8,9	1,2,3,4,6,7,8,9	-	-	1,2,3,4,5,7,8,9	-	8,9	2,3,4,5,6,7,8,9	3,4,5,8
13	1,2,3,6,7,9	1,2,3,4,7,9	1,2,3,7	-	-	1,5,7,9	1,7,9	1,2,3,4,5,6,7,8,9	-	-	1,2,3,4,5,7,9	1,2,3,4,5,6,7	-	1,2,3,4,5,6,7,8,9	1,2,3,4,5,6,7,8
14	1,7,9	1,3,9	-	-	-	9	-	1,3,4,6,7,8,9	-	-	1,3,7	1	-	-	1,3,5
15	1,2,7,9	2,9	2,7	-	-	7,9	7,9	1,2,4,6,7,8,9	-	-	1,2,3,7,9	2,7	9	2,6,7,9	-

4.4.4 Concordance and Discordance Matrix

The concordance and discordance matrix constructed from the sets before. The value of the matrix is the sum of the weight of the criteria in concordance and discordance sets. The equation to calculate the matrix element are

$$c_{kl} = \sum_{j \in c_{kl}} w_j \quad (4.3)$$

For example, the calculation of concordance matrix element C_{12}

$$C_{12} = W_1 + W_2 + W_5 + W_6 + W_7 + W_8 + W_9$$
$$C_{12} = 14{,}7 + 11.9 + 7{,}6 + 14{,}8 + 13{,}7 + 9 + 8.8$$
$$C_{12} = 80{,}5$$

To construct the discordance matrix, the equation used to calculate the matrix element are

$$d_{kl} = \frac{max\{|v_{kj} - v_{ij}|\}_{j \in D_{kl}}}{max\{|v_{kj} - v_{ij}|\}_{\forall_j}} \quad (4.4)$$

For example, the calculation of D_{12} is shown below

$$d_{12} = \frac{max\{|v_{1j} - v_{2j}|\}_{j \in D_{12}}}{max\{|v_{1j} - v_{2j}|\}_{\forall_j}}$$
$$d_{12} = \frac{max\{0{,}0906;0{,}0052\}}{max\{0{,}481;0{,}088;0{,}09;0{,}05;0{,}174;0{,}21;0{,}369;0{,}22;0{,}188\}}$$
$$d_{12} = \frac{0.0906}{0.481} = 0{,}1822$$

After the calculation each concordance and discordance matrix element, the concordance and discordance matrix result is shown below

Table 4. 26 Concordance Matrix

	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}	C_{13}	C_{14}	C_{15}
C_1	0	80.5	100	100	100	83.4	91	23.5	100	100	59.2	70.4	91	49.5	49.1
C_2	19.5	0	74.4	100	100	69.7	69.7	12.3	100	100	8.8	49.2	68.6	35.8	46.7
C_3	19.1	25.6	0	91	91	59.8	74.6	0	83.4	100	11.9	37.9	59.8	14.7	25.6
C_4	0	0	9	0	53.9	0	0	0	85.2	70.5	0	0	13.7	0	0
C_5	0	0	9	77.6	0	11.9	24.2	0	77.6	77.6	0	0	13.7	0	0
C_6	16.6	53.9	54.9	100	100	0	83.8	7.6	100	100	17.8	39.1	57.1	23.5	22.5
C_7	16.6	30.3	40.1	100	100	56.5	0	0	100	100	17.8	31.5	53.8	23.5	22.5
C_8	100	100	100	100	100	100	100	0	100	100	80.1	100	100	80.5	92.4
C_9	0	0	16.6	23.8	31.4	0	0	0	0	31.4	0	0	0	0	0
C_{10}	0	0	16.6	50.6	31.2	0	0	0	68.6	0	0	0	0	0	0
C_{11}	76.4	91.2	100	100	100	82.2	91	48.3	100	100	0	85.2	91	56.7	68.6
C_{12}	29.6	78.9	74.4	100	100	82.2	82.2	7.6	100	100	14.8	0	82.2	14.7	63.9
C_{13}	23.8	31.4	47.4	100	100	55.2	62.8	0	100	100	23.8	17.8	0	0	8.8
C_{14}	62.8	64.2	100	100	100	91.2	100	19.5	100	100	59.3	85.3	100	0	65.4
C_{15}	50.9	79.3	74.4	100	100	77.5	77.5	19.9	100	100	38.6	74.4	91.2	50.8	0

Table 4. 27 Discordance Matrix

	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}	C_{13}	C_{14}	C_{15}
C_1	0	1	1	1	1	1	1	0	1	1	0.926	1	1	1	0.6613
C_2	0.1882	0	1	1	1	1	1	0	1	1	0.1136	0.8588	1	0.2756	0.2493
C_3	0	0.5868	0	1	1	0.5894	0.5239	0	1	1	0	0.2187	0.6848	0	0.1981
C_4	0	0	0.1111	0	1	0	0	0	1	1	0	0	0	0	0
C_5	0	0	0.071	0.6846	0	0	0	0	1	1	0	0	0	0	0
C_6	0.1111	0.8265	1	1	1	0	1	0	1	1	0.1111	0.9464	1	0.0891	0.3601
C_7	0.2222	0.8265	1	1	1	0.3549	0	0	1	1	0.2222	0.7098	1	0	0.2161
C_8	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1
C_9	0	0	0.1262	0.5048	0.6858	0	0	0	0	0.4032	0	0	0	0	0
C_{10}	0	0	0	0.9128	0.7967	0	0	0	1	0	0	0	0	0	0
C_{11}	1	1	1	1	1	1	1	0.3435	1	1	0	1	1	1	1
C_{12}	0.2739	1	1	1	1	1	1	0	1	1	0.4572	0	1	0.5511	0.1761
C_{13}	0.1555	0.7776	1	1	1	0.2992	0.8572	0	1	1	0.1555	0.648	0	0	0.108
C_{14}	0.7776	1	1	1	1	1	1	0.6912	1	1	0.626	1	1	0	1
C_{15}	1	1	1	1	1	1	1	0.9465	1	1	0.7362	1	1	0.5455	0

4.4.5 Dominant Concordance and Discordance Matrix Determination

The next step in ELECTRE method after determining concordance and discordance matrix is determine the dominant matrix for each concordance and discordance matrix. Before determining the dominant matrix, it need to calculate the threshold value for both concordance and discordance. The threshold value of concordance and discordance is calculated below

$$c = \frac{\sum_{k=1}^{m}\sum_{l=1}^{m} c_{kl}}{m(m-1)}$$

$$c = \frac{11237{,}5}{15(15-1)} = 53.51$$

and for the discordance threshold value caluclation is

$$d = \frac{\sum_{k=1}^{m}\sum_{l=1}^{m} d_{kl}}{m(m-1)}$$

$$d = \frac{129}{15(15-1)} = 0.616$$

To consturct the dominant concordance and discordance matrix, the matrix element is constructed using equation

$$f_{kl} = \begin{cases} 1, if\ c_{kl} \geq c \\ 0, if\ c_{ki} < c \end{cases} \ and\ \ g_{kl} = \begin{cases} 1, if\ d_{kl} \geq d \\ 0, if\ d_{ki} < d \end{cases} \qquad (4.5)$$

and the result of dominant concordance and discordance matrix is

Table 4. 28 Dominant Concordance Matrix

	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}	C_{13}	C_{14}	C_{15}
C_1	0	1	1	1	1	1	1	0	1	1	1	1	1	0	0
C_2	0	0	1	1	1	1	1	0	1	1	0	0	1	0	0
C_3	0	0	0	1	1	1	1	0	1	1	0	0	1	0	0
C_4	0	0	0	0	1	0	0	0	1	1	0	0	0	0	0
C_5	0	0	0	1	0	0	0	0	1	1	0	0	0	0	0
C_6	0	1	1	1	1	0	1	0	1	1	0	0	1	0	0
C_7	0	0	0	1	1	1	0	0	1	1	0	0	1	0	0
C_8	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1
C_9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C_{10}	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
C_{11}	1	1	1	1	1	1	1	0	1	1	0	1	1	1	1
C_{12}	0	1	1	1	1	1	1	0	1	1	0	0	1	0	1
C_{13}	0	0	0	1	1	1	1	0	1	1	0	0	0	0	0
C_{14}	1	1	1	1	1	1	1	0	1	1	1	1	1	0	1
C_{15}	0	1	1	1	1	1	1	0	1	1	0	1	1	0	0

Table 4. 29 Dominant Discordance Matrix

	D_1	D_2	D_3	D_4	D_5	D_6	D_7	D_8	D_9	D_{10}	D_{11}	D_{12}	D_{13}	D_{14}	C_{15}
D_1	0	1	1	1	1	1	1	0	1	1	1	1	1	1	1
D_2	0	0	1	1	1	1	1	0	1	1	0	1	1	0	0
D_3	0	0	0	1	1	0	0	0	1	1	0	0	1	0	0
D_4	0	0	0	0	1	0	0	0	1	1	0	0	0	0	0
D_5	0	0	0	1	0	0	0	0	1	1	0	0	0	0	0
D_6	0	1	1	1	1	0	1	0	1	1	0	1	1	0	0
D_7	0	1	1	1	1	0	0	0	1	1	0	1	1	0	0
D_8	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1
D_9	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
D_{10}	0	0	0	1	1	0	0	0	1	0	0	0	0	0	0
D_{11}	1	1	1	1	1	1	1	0	1	1	0	1	1	1	1
D_{12}	0	1	1	1	1	1	1	0	1	1	0	0	1	0	0
D_{13}	0	1	1	1	1	0	1	0	1	1	0	1	0	0	0
D_{14}	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1
D_{15}	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0

4.4.6 Aggregate Dominance Matrix Determination

The aggregate dominance matrix element is calculate using the equation

$$e_{kl} = f_{kl} x g_{kl} \quad (4.6)$$

And the calculation example of e_{12} is

$$e_{12} = f_{kl} x g_{kl} = 0\ x\ 0 = \ 0$$

And the result of the aggregate dominance matrix is

Table 4. 30 Aggregate Dominance Matrix

	e_{k1}	e_{k2}	e_{k3}	e_{k4}	e_{k5}	e_{k6}	e_{k7}	e_{k8}	e_{k9}	e_{k10}	e_{k11}	e_{k12}	e_{k13}	e_{k14}	e_{k15}
e_{1l}	0	1	1	1	1	1	1	0	1	1	1	1	1	0	0
e_{2l}	0	0	1	1	1	1	1	0	1	1	0	0	1	0	0
e_{3l}	0	0	0	1	1	0	0	0	1	1	0	0	1	0	0
e_{4l}	0	0	0	0	1	0	0	0	1	1	0	0	0	0	0
e_{5l}	0	0	0	1	0	0	0	0	1	1	0	0	0	0	0
e_{6l}	0	1	1	1	1	0	1	0	1	1	0	0	1	0	0
e_{7l}	0	0	0	1	1	0	0	0	1	1	0	0	1	0	0
e_{8l}	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1
e_{9l}	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
e_{10l}	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
e_{11l}	1	1	1	1	1	1	1	0	1	1	0	1	1	1	1
e_{12l}	0	1	1	1	1	1	1	0	1	1	0	0	1	0	0
e_{13l}	0	0	0	1	1	0	1	0	1	1	0	0	0	0	0
e_{14l}	1	1	1	1	1	1	1	0	1	1	1	1	1	0	1
e_{15l}	0	1	1	1	1	1	1	0	1	1	0	1	1	0	0

4.4.7 Favorable Alternative Determining

In selecting the favorable alternative, the column in the matrix is representing each alternatives. The column with most element equal to 1 is the best alternative. Therefore, the best alternative based on the aggregate dominance matrix is

Table 4. 31 Alternative Selection Recapitulation

Highland Rice	0	1	1	1	1	1	1	0	1	1	1	1	1	0	0	11
Corn	0	0	1	1	1	1	1	0	1	1	0	0	1	0	0	8
Chili	0	0	0	1	1	0	0	0	1	1	0	0	1	0	0	5

Chayote	0	0	0	0	1	0	0	0	1	1	0	0	0	0	0	3
Avocado	0	0	0	1	0	0	0	0	1	1	0	0	0	0	0	3
Papaya	0	1	1	1	1	0	1	0	1	1	0	0	1	0	0	8
Sand Ginger	0	0	0	1	1	0	0	0	1	1	0	0	1	0	0	5
Diary Cattle	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	14
Quailbird	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Quailbird's Egg	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
Cow's Milk	1	1	1	1	1	1	1	0	1	1	0	1	1	1	1	13
Tobacco Industry	0	1	1	1	1	1	1	0	1	1	0	0	1	0	0	9
Wood & Webbing Industry	0	0	0	1	1	0	1	0	1	1	0	0	0	0	0	5
Furniture Industry	1	1	1	1	1	1	1	0	1	1	1	1	1	0	1	13
Metal Industry	0	1	1	1	1	1	1	0	1	1	0	1	1	0	0	10

From ELECTRE method result, the maximum total number of aggregate dominance matrix element is 14 for dairy cattle commodity. The second largest sum of aggregate dominance matrix element is cow's milk and furniture industry with 13. There will be several analysis to determine the favorable competitive commodity in Boyolali in the next chapter.

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CHAPTER V
DATA INTERPRETATION AND ANALYSIS

This chapter consists of the interpretation and analysis of the calculation result. The analysis of the data consist of the alternative selection analysis based on multi-criteria decision-making calculation using ELECTRE method in the previous chapter, the value chain analysis of selected favorable competitive product in Boyolali, and the core competencies of Boyolali regency based on the innovation system developed in this research.

5.1 Alternative Selection Analysis

The alternative selection analysis will divided into two sub-chapter, which are the competitive commodity selection analysis and the sensitivity analysis.

5.1.1 Competitive Commodity Selection Analysis

Based on the calculation of competitive selection using multi-criteria decision-making method, there are three commodities that superior to other commodities, which are dairy cows commodity, cow's milk commodity, and furniture industry. The calculation result of these commodities is described in table 5.1 to table 5.3 below

Table 5. 1 Alternative Concordance Matrix

Commodity															Sum
Dairy Cattle	1	1	1	1	1	1	1	0	1	1	1	1	1	1	14
Cow's Milk	1	1	1	1	1	1	1	0	1	1	0	1	1	1	13
Furniture Industry	1	1	1	1	1	1	1	0	1	1	1	1	1	0	1	13

Table 5. 2 Alternative Discordance Matrix

Commodity															Sum
Dairy Cattle	1	1	1	1	1	1	1	0	1	1	1	1	1	1	14
Cow's Milk	1	1	1	1	1	1	1	0	1	1	0	1	1	1	13
Furniture Industry	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	14

Table 5. 3 Aggregate Dominant Matrix

Commodity																Sum
Dairy Cattle	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	14
Cow's Milk	1	1	1	1	1	1	1	0	1	1	0	1	1	1	1	13
Furniture Industry	1	1	1	1	1	1	1	0	1	1	1	1	1	0	1	13

The concordance test allows the decsision maker to determine if one alternative is superior to other alternative in a criteria. While the discordance test is determining if the alternative have constant high value for all criteria. For instance, when an alternative has the best values for some criteria, but at the same time it has low values in other criteria, it is likely to pass the concordance test but not the discordance test.

From the table, dairy cows livestock and cow's milk has constant result of concordance and discordance result. While in furniture industry commodity, the concordance and discordance test result have different result. The number of discordance elements is higher than the concordance matrix. It means that furniture industry commodity is better than most other commodity, but in one criteria, furniture industry commodity is not the best. While the rest two commodity, which are dairy cattle livestock and cow's milk commodity, is consistent in both concordance and discordance test. However, since the dairy cattle livestock have higher number of dominance concordance and discordance, the dairy cattle livestock assigned as the favorable competitive commodity in Boyolali Regency.

5.1.2 Sensitivity Analysis

Before the strategies development of favorable competitive commodity in the regency, there will be some sensitivity analysis for the competitive commodity selection. The sensitivity analysis done to study the uncertainty of the output of the mathematical model or the multi-criteria decision-making. The variable that will have sensitivity analysis is the criteria weight. The criteria weight is obtained from the expert appraisal for the criteria. The sensitivity analysis will described in table 5.4 below

Table 5. 4 Criteria Sensitivity Analysis Aggregate Dominance Matrix (1)

Criteria	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	
Weight	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	
Commodity										Sum
Highland Rice	0	1	1	1	1	1	0	1	1	1	1	1	0	0	11
Corn	0	0	1	1	1	1	0	1	1	0	0	1	0	0	8
Chili	0	0	0	1	1	0	0	0	1	1	0	0	0	0	4
Chayote	0	0	0	0	1	0	0	0	1	1	0	0	0	0	3
Avocado	0	0	0	1	0	0	0	0	1	1	0	0	0	0	3
Papaya	0	1	1	1	1	0	1	0	1	1	0	0	1	0	8
Sand Ginger	0	0	0	1	1	0	0	0	1	1	0	0	1	0	5
Dairy Cattle	1	1	1	1	1	1	1	0	1	1	1	1	1	1	14
Quail Bird	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Quail Bird's Egg	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
Cow's Milk	1	1	1	1	1	1	1	0	1	1	0	1	1	1	13
Tobacco Industry	0	1	1	1	1	1	1	0	1	1	0	0	1	0	9
Wood Goods & Webbing Industry	0	0	0	1	1	0	1	0	1	1	0	0	0	0	5
Furniture Industry	1	1	1	1	1	1	1	0	1	1	1	1	1	0	13
Metal Goods Industry	0	1	1	1	1	1	1	0	1	1	0	1	1	0	10

After the calculation of sensitivity by changing all the criteria weight into the same value, there are no significant change to the result of aggregate dominance matrix. The best alternative still the same with the result before where the criteria appraisal is based on the expert's judgment. The next sensitivity analysis will change the criteria weight into different value.

Table 5. 5 Criteria Sensitivity Analysis Aggregate Dominance Matrix (2)

Criteria	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	
Weight	15	6.25	15	6.25	15	6.25	15	6.25	15	
Commodity										Sum
Highland Rice	0	1	1	1	1	1	1	0	1	11
Corn	0	0	1	1	1	1	1	0	1	8
Chili	0	0	0	1	1	0	0	0	1	5
Chayote	0	0	0	0	0	0	0	0	1	2
Avocado	0	0	0	1	0	0	0	0	1	3
Papaya	0	1	1	1	1	0	1	0	1	8
Sand Ginger	0	0	0	1	1	0	0	0	1	5
Dairy Cattle	1	1	1	1	1	1	1	0	1	14
Quail Bird	0	0	0	0	0	0	0	0	0	0
Quail Bird Egg	0	0	0	0	0	0	0	0	1	1
Cow's Milk	1	1	1	1	1	1	1	0	1	13
Tobacco Industry	0	1	1	1	1	1	1	0	1	9
Wood Goods & Webbing Industry	0	0	0	1	1	0	0	0	1	4
Furniture Industry	1	1	1	1	1	1	1	0	1	13
Metal Goods Industry	0	1	1	1	1	1	1	0	1	10

Table 5. 6 Criteria Sensitivity Analysis Aggregate Dominance Matrix (3)

Criteria	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	
Weight	8	15	8	15	8	15	8	15	8	
Commodity										Sum
Highland Rice	0	1	1	1	1	1	1	0	1	11
Corn	0	0	1	1	1	1	0	0	1	6
Chili	0	0	0	1	1	0	0	0	1	4
Chayote	0	0	0	0	1	0	0	0	1	3
Avocado	0	0	0	1	0	0	0	0	1	3
Papaya	0	1	1	1	1	0	1	0	1	8
Sand Ginger	0	0	0	1	1	0	0	0	1	5

Table 5. 7 Criteria Sensitivity Analysis Aggregate Dominance Matrix (3) (Cont)

Criteria	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9
Weight	8	15	8	15	8	15	8	15	8
Commodity									Sum
Dairy Cattle	1 1	1 1	1 1	1 1	1 0	1 1	1 1	1 1	14
Quail Bird	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0
Quail Bird's Egg	0 0	0 0	0 0	0 0	1 0	0 0	0 0	0 0	1
Cow's Milk	1 1	1 1	1 1	1 1	1 0	1 1	1 1	1 1	13
Tobacco Industry	0 1	1 1	1 1	1 1	1 0	1 1	0 0	0 0	8
Wood Goods & Webbing Industry	0 0	0 1	1 1	1 1	1 0	1 1	0 0	0 0	6
Furniture Industry	1 1	1 1	1 1	1 1	1 0	1 1	1 1	0 1	13
Metal Goods Industry	0 1	1 1	1 1	1 1	1 0	1 1	0 1	0 0	10

After the sensitivity analysis to the criteria weight, the result of alternative choosen has not change significantly, especially for the best three alternatives. From all the sensitivity analysis, it shown that the commodity choosen from the calculation using criteria weight from the expert is completely dominating other commodity. Some of the values of other commodity changes in the sensitivity analysis. However, the best three commodity alternatives, which are dairy cattle livestock, cow's milk, and furniture industry has exactly the same result with the original calculation.

5.2 Competitive Commodity Strategy Development

After the selection of the featured competitive commodity based on multi-criteria decision-making method, this subchapter will discuss the development of strategies for increasing the industry value of the commodity. The strategy development for the competitive commodity divided into the existing condition of the commodity in the regency and the strategy development using value chain analysis to increase the utilization of the commodity.

5.2.1 Existing Dairy Cattle Livestock Commodity Analysis

Boyolali has the biggest population of dairy cattle in Middle Java. . In 2014, the population of dairy cattle recorded at 72.123 cows. Dairy cattle livestock spreaded in six districts in Boyolali, which are Selo, Ampel, Cepogo, Musuk, Boyolali, and Mojosongo. The detailed data of dairy cattle population will described in table 5.7 below

Table 5. 8 Boyolali Dairy Cattle Population

Type of Livestock	Children		Young Cows		Adult Cows	
	Male	Female	Male	Female	Male	Female
Dairy Cattle	9116	8730	7557	10080	7034	29605

Source: Dinas Peternakan dan Perikanan Kabupaten Boyolali

Beside for the regency breeding of dairy cattle, Boyolali also provide some dairy cattle to all region in Indonesia. Recorded 5.123 female cows seeds distributed to other regencies and 6.775 female cows seeds distributed to West Java. In order to develop better dairy cattle livestock, the animal husbandry department of Boyolali already has the insemination program with the certificate of decent dairy cattle seed.

From the data provided, most of the population of the dairy cattle is female cows. That lead the main product of the dairy cattle livestock is the cow's milk. But beside the milk, there are several product produces by the livestock of dairy cattle. The product from the livestock will described in the industrial tree below

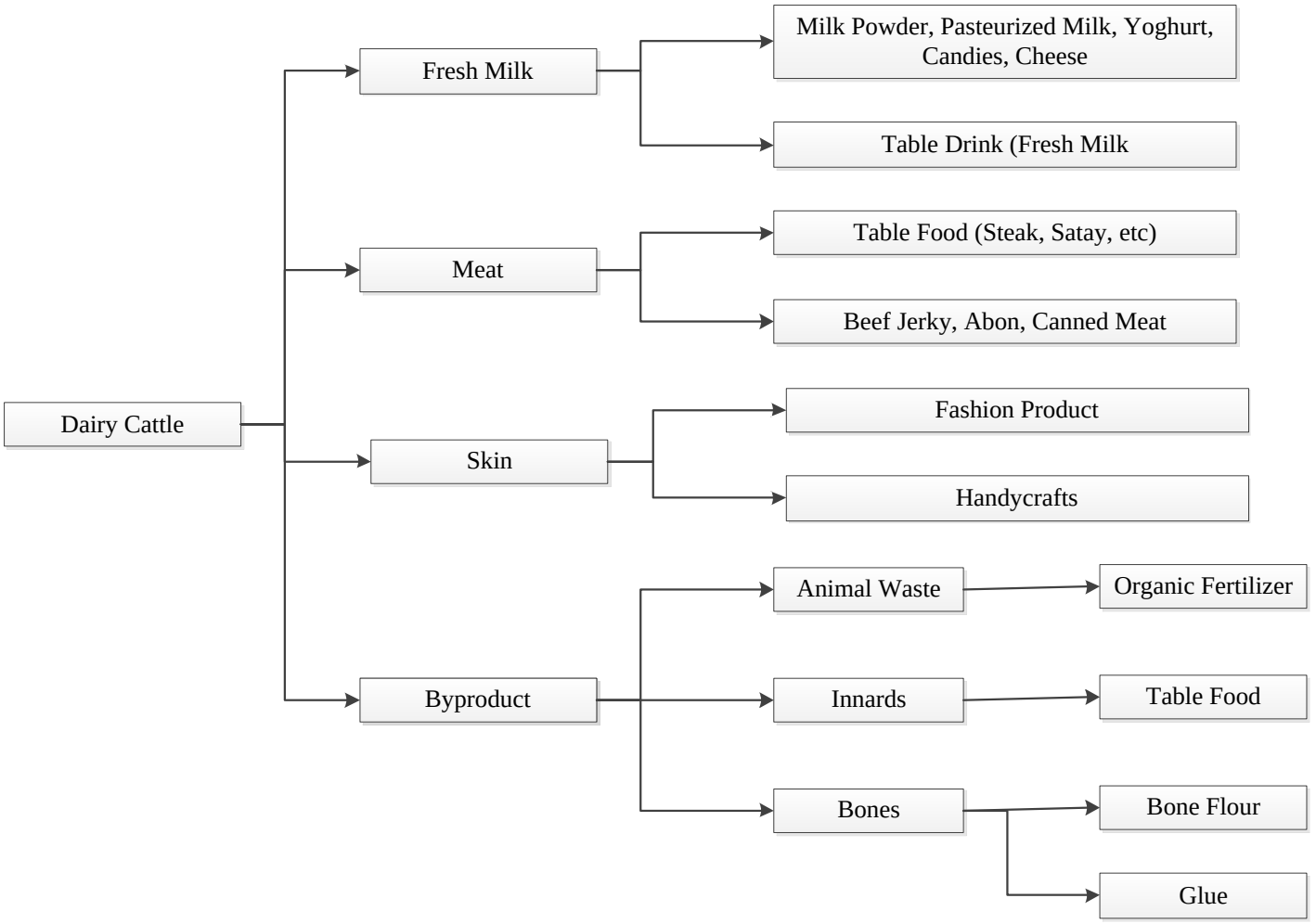


Figure 5. 1 Dairy Cattle Livestock Industrial Tree

5.2.2 Value Chain Analysis

The strategy development of competitive commodity in Boyolali will use the value chain concept by Porter. Value chain analysis will develop the strategy based on the activities in an organization and the interaction between the activities. The strategies development of the competitive product will divided based on the distribution chain of the product. The distribution chain of Dairy Cattle livestock will described in figure 5.2 below

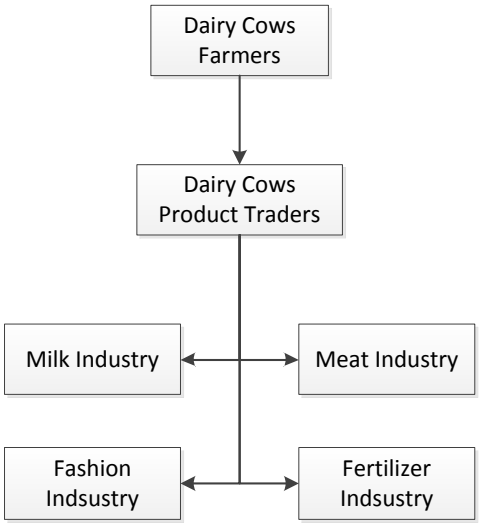


Figure 5. 2 Dairy Cattle Livestock Distribution Chain

To perform the value chain analysis, there are several steps needed to be done. The typical value chain analysis by Porter can be performed by analyzing the every single activities that related to the cost of the organization. The next step of value chain analysis is the analysis of how the product in the commodities fit into customer. The third step of performing value chain analysis is to identify the potential cost advantages by performing the value chain analysis. The last step of value chain analysis is the identification of potential value added for the customer.

5.2.2.1 Dairy Cattle Commodity Cost Related Activity

In value chain analysis by Porter, the activities of an organization is divided into two, primary activities and supporting activities. All the activities in value chain analysis is intended to create margin for the dairy cattle commodity especially for cost variable. All the activities in most of dairy cattle commodities in Boyolali are listed in the table 5.9 and 5.10 below

Table 5. 9 Cost Related Primary Activities

Indicator	Activities	References
Inbound Logistic	Negotiation Power with Supplier	Porter (1994)
	Material & Tools Selection	Asmarawitjitra (1991)
	Material Handling	Asmarawitjitra (1991)
	Material & Tools Price Changes Handling	Asmarawitjitra (1991)
Operation	Product Quality Control	Porter (1994)
	Production Process Control	Dirlanudin (1999)
Outbound Logistic	Warehouse & Storage Management	Dirlanudin (1999)
	Product Shipment	Dirlanudin (1999)
Marketing and Sales	Customer Relationship	Sviokla (1993)
	Price Determination	Soman, Dilip (2010)
	Communication Program	Vavra (1995)
Support & Service	Tools Maintenance	O'Brien (1991)
	Product Adaptation to Customer Expectation	Kotler (1994)

Table 5. 10 Cost Related Supporting Activities

Indicator	Activities	References
Firm Infrasturcture	Capital Needed	Thimpson & Stricklans (1987)
	Organization Structure	Porter (1994)
Human Resource Management	Employee Training	Helliegell (1992)
	Work Environment	Harrison (1983)
	Selective Recruitment	David (1995)
Technology & Development	Organization Management Information System	Davis & Olson (1984)
	Technology Comperhension	Wignyo & Mulianto (2002)
Procurement	Supplier Selection	Lock (1992)
	Production Tools Procurement	Dobler et all. (1990)

From table 5.9 and 5.10, the activities listed are the ones that have relation with the cost of the organization. These activities will be the basic to perform the value chain analysis for the commodities in Boyolali

5.2.2.2 Dairy Cattle Customers Analysis

The main purpose of the whole activities and production in the dairy cattle commodity is to produce something for which customer willing to pay a price. Porter also stated that the ability to perform the activities and to manage the linkages between activities is a source of competitive advantages of the organization and the willingness of the customer to buy the product. The value chain based strategy will develop a strategy that linkage all the activities with customer to have added value. The relation of value chain activities and customer can be seen in the figure 5.3 below.

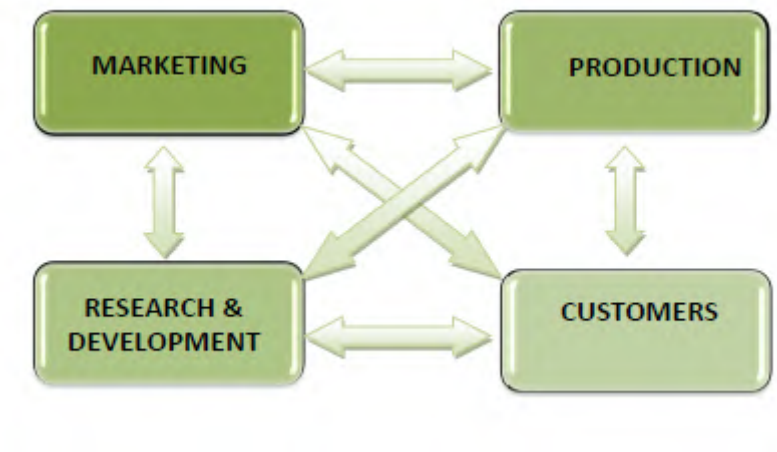


Figure 5. 3 Value Chain and Customers Relationship

Based on Barnes (2000), there are twelve customers criteria to purchasing product which are quality, price, delivery reliability, conformance to standards, packaging, flexibility, capacity to develop new product, capacity to modify product, process innovation capacity, financial stability, offering of credit facilities, and location. To make sure the activities in the dairy cattle commodities to fit into the customer expectation, table 5.11 and 5.12 will describe which activities cover the customer criteria

Table 5. 11 Customer Criteria to Primary Activities

Indicator	Activities	Customer Criteria
Inbound Logistic	Negotiation Power with Supplier	Price, Flexibility
	Material & Tools Selection	Quality, Delivery Reliability
	Material Handling	Delivery Reliability, Conformance to Standards
	Material & Tools Price Changes Management	Price, Flexibility
Operation	Product Quality Control	Quality, Conformance to Standard, Packaging
	Production Process Control	Quality, Delivery Reliability, Conformance to Standard
Outbound Logistic	Warehouse & Storage Management	Location, Delivery Reliability, Packaging
	Product Shipment	Delivery Reliability, Location
Marketing and Sales	Customer Relationship	Delivery Reliability, Flexibility
	Price Determination	Price, Financial Stability
	Communication Program	Offering of Credit Facilities, Financial Stability
Support & Service	Tools Maintenance	Quality, Conformance to Standard
	Product Adaptation to Customer Expectation	Capacity to Modify Product, Quality

Table 5. 12 Customer Criteria to Supporting Activities

Indicator	Activities	Customer Perception
Firm Infrasturcture	Capital Needed	Financial Stability
	Organization Structure	Financial Stability
Human Resource Management	Employee Training	Quality, Conformance to Standard
	Work Environment	Quality, Conformance to Standard
	Selective Recruitment	Financial Stability, Capacity to Modify Product
Technology & Development	Organization Management Information System	Financial Stability, Process Innovation Capacity.
	Technology Comperhension	Capacity to Develop New Product, Capacity to Modify Product, Quality, Price

Table 5. 13 Customer Criteria to Supporting Activities (Cont)

Indicator	Activities	Customer Perception
Procurement	Supplier Selection	Quality, Price, Delivery Reliability, Conformance to Standard
	Production Tools Procurement	Quality, Price, Conformance to Standard.

5.2.2.3 Dairy Cattle Commodity Value Chain Analysis

The breeding process of dairy cattle is the first process in the distribution chain of dairy cattle commodity. Based on value chain concept by Porter, the activities of the organization divided into the primary activities and supporting activities. The primary activities for dairy cattle livestock commodity including the inbound logistic, operation process, outbound logistic, sales and marketing, and the services activities. While the supporting activitis for the commodity including the firm infrastructure, human resource management, technology development, and procurement activities.

The development of value chain analysis for dairy cattle commodity in Boyolali also based on the research of other countries dairy cattle management such as in United States (CGGC Duke Univesity, 2009) and Sri Lanka (Achchuthan, 2012). The research of value chain analysis in US by Duke University is to improve the contribution of cows and dairy product to gas emissions in the US. While in Sri Lanka is to evaluate the effectiveness of the value chain analysis in Kilinochichi, Sri Lanka. Some of activities in value chain that might add the efficiency of dairy cattle commodity in Boyolali is taken from this research. Another consideration of value chain analysis development is from the discussion session with the dairy cattle commodity expert in Boyolali.

In firm infrastructure, there is no detailed firm infrastructure for most dairy cattle livestock in Boyolali. Usually the livestock owned by one or more owner. Every livestock has a manager who understands the characteristic of dairy cattle and how to manage the livestock. The manager of the livestock usually have

veterinarian degree and work as the vet. Under the manager there are several employee that run the daily works of the livestock.

In human management activities, the human resource quality in dairy cattle livestock mostly recruited from close relationship of the owner. There is one or two expert in cows farming for each livestock. The rest of the employee did the job based on the lead of the expert and did the daily routines everyday. The payment for the employee is variative based on the time of service of the employee. In the beginning, the salary of the employee relatively low and as time goes by the salary will increase. The employee only learn the dairy cattle livestock management through experiment and from the other employee who has more experience.

In technology development, the livestock use intermediate technology as the tool to produce the product. There are no special research team in most of livestock in Boyolali. The technology improvement only based on daily routines and accidently found improvement. Most of the livestock obtained the newest technology from the government notice. Since Boyolali's government also fully supporting the development of dairy cattle commodity, there are some research in government level. The result of the research will distributed to the local livestock to increase the regency's production.

In procurement activities, the seed of dairy cattle is obtained from local livestock. Every livestock in Boyolali also breed their own cows for the future investment. Some farming tools such as milking tools, butchery tools, and caging construction purchased from local seller.

In the primary activities, started from the inbound logistic, the breeding tools used by most of the livestock in Boyolali already in medium to high technology. There are some support from the government for the dairy cattle farmer to introduce the technology for farming. In general, most of the livestock did not have any problem to reach the tools to run the livestock. However, if the livestock able to have their own research, without waiting the government. They will improve the inbound logistic faster.

The next primary activity is the operations activity, which is the most crucial activities in the livestock. The operation activity of dairy cattle livestock as follows

1. Livestock Facilities and Equipment Preparation

   The first operation of dairy cattle livestock is the preparation of the facilities and equipment, especially the cage. To reach the best quality of dairy cattle, there are several standards for the facilities such as the cage size for the cows. There are differential for male, female or young cows for the size. Once the cows growth, they will moved into other cage. The

2. Cows Breeding and Nursery

   The second operation is the breeding and nursery of the dairy cattle. Most of the dairy cattle breed in Boyolali is *Fresian Holstain* species. To have the best cows and best production, there is also several standards for good female dairy milk such as the head shape, the muscle amount, and milk production. The most important standard for the cows breeding is the frequency of childbirth by the female cows. Other than for the future breeding of the livestock. A cow, which easier to have pregnancy will produce more milk.

3. Cows Health and Sanitation

   Disorders and disease for cows will hamper the production of the livestock and affect the economic value of the livestock also. There are parameters called Body Conditioning Scoring for the dairy cattle. A good BCS score will let the cows to be maintained in the livestock. Other than the cows health itself, there are also several factors need to be considered such as a good and clean environment for the cows, good milking scheduling, and good breeding tools.

4. Cows Feeding Management

   Cows feed comes from several kind of grass. Usually dairy cattle feed for two times a day. There are three types of cows feeding, grazing system, caging system, or the combination of those two.

5. Dairy cattle Milking

   Once the female dairy cattle producing milk. The livestock need to prepare the milking process. The scheduling of milking the cows is daily to maximize the milk production. The female cows that ready to milk is separated from other cows in most of the livestock in Boyolali. The standard procedure of milking the cows from cleaning the cage, cow's nipple, and the milking process need to be done in sterile condition.

6. Dairy cattle Milk Quality Control

   After the milking process, to make sure all the milk production is consumable, there will be quality control for the milk produced that day. The quality control of milking process also done after all the milking process. The milk have three different quality checking, which are organoleptic, physical, and chemical test. Once the milk failed one of the test, the milk will be rejected in the livestock. There are several standard by the livestock that need to fulfill by the milk in that day.

7. Dairy cattle Butchery

   Dairy cattle livestock also have the butchery process as a side operation. A male or female cows which did not productive for breeding or milking will goes to the butchery process. The butchery of dairy cattle will produce some other products as explained in the industrial tree such as meat, skin, and other byproduct.

In outbound logistic activities, the product from the livestock will be carried using large size vehicle. For milk product, there is special tank to keep the milk in the temperature and secure from the germ and dirt. After the outbound logistic of the product to the traders location based on the agreement before the production.

In sales and marketing activity, the sales of dairy product produced by dairy cattle is sold to the trader before distributed to the specific industry. Mostly the price maker is the trader based on the demand and economic condition in Boyolali. The livestock forcedly accept the price set by the traders. Some problems in sales and marketin activities is the presence of some broker in the transaction. The broker presence in the transaction will reduce the production of the regency.

Boyolali government already provide Koperasi Unit Desa (KUD) to manage the sales of dairy product. However, there is still some illegal activities by the broker to force the livestock sells the product to them.

In support and services, Boyolali government fully support the activities of dairy cattle livestock. The government brand the regency as the city of milk make it easier for the dairy cattle livestock to sell the product. The government also provide some research and subsidary to help the livestock make som improvement. In the lower level, some livestock tried to improve the service to the customer by providing transportation of the product with excellent equipment to maintain the quality of the product. Before sold to the customer, the product also have tight quality control.

Table 5. 14 Dairy Cattle Livestock Value Chain Analysis

Supporting Activities	Firm Infrastructure					MARGIN
	Management layers calculation to reduce overhead cost		Standarized accounting practices or experts recruitment. Some livestock			
	Human Resouce Management					
	Developing effective orientation and training for new employee		Minimize underpaid employee in the livestock by increasing the productivity of the employee and reduce the number of personnel			
	Technology Development					
	Develop own research unit for each livestock		Effective usage of technology to reduce the manufacturing scrappage			
	Procurement					
	Creating sharing purchasing operations between each livestocks		Developing policy guidelines for the livestock tools and equipment to have the lowest cost material and acceptable quality			
Primary Activities	Inbound Logistic	Operations	Outbound Logistics	Sales & Marketing	Support & Services	
	The dairy calves raised in local livestock.	The operation including preparation, breeding, health, feeding, milking, and quality control are done by each livestock.	The product distribution to the trader or industry is based on the agreement made before the production	The sales of the product is directly to the trader to reduce the cost of sales	The accuracy of order fulfillment by the trader or industry in terms of quality and quantity	
	Raw material supply such as breeding tools and equipment obtained from coopertaion with local company			The sales target of the product is local industry or SME	The tight quality control process especially for cows quality and fresh milk quality	
	The storage for the products is depends on the livestock ability and policy	The final product of dairy cattle livestock is the cows, fresh milk, meat, skin, animal waste, innards, and bones.	The product transportation using land vehicle to the trader location.	Some of the dairy calves also sent to other regency or province to increase the income of the livestock		

5.2.2.4 Profit Margin Analysis

The value chain analysis strategy hopefully able to increase the profit marigin of the dairy livestock commodity. The calculation of profit marigin of a dairy livestock in Boyolali will described in the table below. The profit marigin is calculated for one of the livestock in Boyolali with 28 dairy cattle. The calculation of the profit margin also applied for 300 days of lactation period.

Table 5. 15 Dairy Cattle Livestock Profit Margin Calculation

Outcome		
Variable Cost		
Animal Feed	Rp	150,000,000.00
Concentrate	Rp	24,000,000.00
Vaccine	Rp	1,000,000.00
Electricity and Fuel	Rp	1,000,000.00
Labor Cost	Rp	30,000,000.00
Other Cost	Rp	5,000,000.00
Parent Lactation	Rp	120,000,000.00
Fixed Cost		
Cage Depreciation	Rp	850,000.00
Tools Depreciation	Rp	1,650,000.00
Total Outcome	Rp	333,500,000.00
Income		
Milk	Rp	325,000,000.00
Meat	Rp	150,000,000.00
Compost	Rp	76,000,000.00
Total Income	Rp	551,000,000.00
Profit Marigin	Rp	217,500,000.00

The calculation shows the profit margin of a livestock per 28 cows per 300 days lactation period is 39%. This margin is relatively big and able to increase more when the core competencies is run excellently.

5.3 Core Competencies Analysis

In the development of dairy cattle commodity in Boyolali regency, the value chain analysis already provide the crucial point of value added activities in the commodity. After the strategies for the development, the competitive commodity need more study about technical aspect. The technical studies including the state of technology for the development of the commodity and the competencies

in human resource (skill and knowledge). Based on the value chain analysis before, the core competencies analysis will applied to the breeding of dairy cattle and dairy milk processing.

The breeding of dairy cattle in Boyolali is one of the priorities in order to add more value to the competitive commodity. In the process, there are several technologies that able to applied and some knowledge and skills for the human resource.

Table 5. 15 Dairy Cattle Breeding Core Competencies

Exisitng Competencies	Expected Competencies
1. The technology of cows caging based on the economical value. To fit the big number of cows in the space available 2. The knowledge of dairy cattle species. All species treated similiarly. 3. The knowledge of choosing best female dairy cattle to breed. 4. The knowledge and skills of maintain the health of dairy cattle. The skill and knowledge only owned by the manager in the livestock. 5. The knowledge of feeding and food mixing of dairy cattle need more attention.	1. The technology of cows caging system need to calculate precisely based on the age and gender of the cows. 2. Some species of dairy cattle need to have special treatment. The treatment is based on the body shape, anatomy, and production number. 3. The knowledge of best female dairy cattle need to be improved. Good female dairy cattle can be identified based on the body shape, milk production, and pregnancy frequency. 4. The employee need to understand the basic knowledge to maintain the health and cure some disease of cows. 5. The employee need to understand the feeding method that fit the cows

Exisitng Competencies	Expected Competencies
	in the livestock, the best food mixing for the cows.

After the core competencies development for the breeding of dairy cattle, the next core competencies to add more value to the commodities is milk processing core competencies. Some technologies, knowledge, and skills that able to implemented in the milking process listed in the table 5.10 below

Table 5. 17 Milking Process Core Competencies

Exisitng Competencies	Expected Competencies
1. The technologies and tools of milking the cows. 2. The knowledge of milking scheduling for large number of cows. 3. The employee knowledge of using the milking machine 4. The skill and knowledge of milking method is based on routines. 5. The technologies, knowledge, and skill of handling the milk cows. The existing handling is only based on routines and knowledge transfer from other employee	1. The better milking technologies will improve the working time of milking. 2. The development of milking scheduling will improve the milk quality and amount. 3. The ability of the employee of using the milking machine will reduce the working time and improve the amount of milk produced. 4. There are several milking method and each method has its advantage and disadvantages based on the cows type or condition. Good milking method will produce better quality milk. 5. There are several technologies to keep the milk from germ while handling the milk.

5.4 Institutional Development Strategy

Based on the theory already described in this report, a good innovation system in a region is controlled by three important contributors in triple helix system, which are government, business performer, and research institution. To support the development of dairy cattle commodity in Boyolali, the institution that need to take part are

Table 5. 15 Triple Helix Institutional

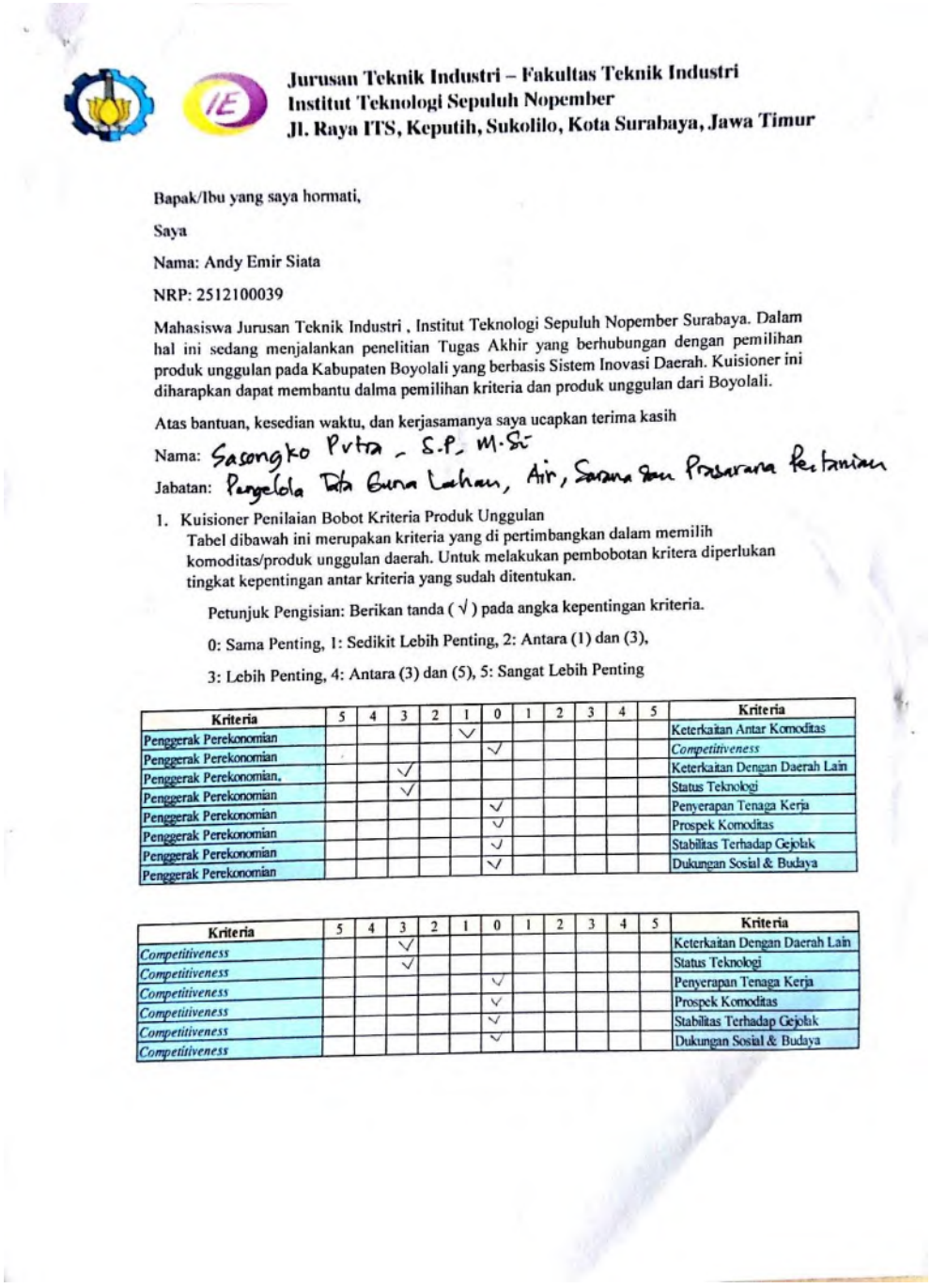
Government	Business Performer	Research Institution
• BAPPEDA Boyolali • Livestock and Fisheries Department (DISNAKKAN) • Milk Regional Owned Enterprises Department (BUMD)	• Local Dairy Cattle Livestock • Regional Unit Cooperation • Milk Processing Industry • Meat Processing Industry	• Nearby Univestity (UGM, UNDIP, etc) • Local vocational school (SMK)

Based on the institutional list, the government role run by BAPPEDA, DISNAKKAN, and Milk BUMD. BAPPEDA as the biggest government institutional in regency's development is managing the macro aspect of dairy cattle livestock commodity development. The coordination of BAPPEDA Boyolali and DISNAKKAN Boyolali is releasing the strategies and policy to run by other institutuin in Boyolali. The government also have an organization called BUMD for milk sector. BUMD take part in the development of dairy cattle and milk in Boyolali by doing the technical process. The business performer in dairy cattle livestock is run by local dairy cattle livestock as the main business performer to produce high quality dairy cattle and its product. Regional Unit Cooperation is the service provider for the local livestock such as loan and tools provider. In addition, the meat and milk industry as the main product of dairy cattle livestock is one of

the business performer. In research institution role, the nearby university such as Universitas Gajah Mada or Univesitas Diponegoro is able to take part in the development of dairy cattle livestock. While local vocational high school (SMK) is also has the capability to improve the commodity in more technical aspect.

APPENDIX

A. Criteria Weighing and Alternative Appraisal Questionnaire Example



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Institut Teknologi Sepuluh Nopember
Jl. Raya ITS, Keputih, Sukolilo, Kota Surabaya, Jawa Timur

Bapak/Ibu yang saya hormati,

Saya

Nama: Andy Emir Siata

NRP: 2512100039

Mahasiswa Jurusan Teknik Industri , Institut Teknologi Sepuluh Nopember Surabaya. Dalam hal ini sedang menjalankan penelitian Tugas Akhir yang berhubungan dengan pemilihan produk unggulan pada Kabupaten Boyolali yang berbasis Sistem Inovasi Daerah. Kuisioner ini diharapkan dapat membantu dalma pemilihan kriteria dan produk unggulan dari Boyolali.

Atas bantuan, kesedian waktu, dan kerjasamanya saya ucapkan terima kasih

Nama: Sasongko Putra, S.P, M.Si

Jabatan: Pengelola Data Guna Lahan, Air, Sarana dan Prasarana Pertanian

1. Kuisioner Penilaian Bobot Kriteria Produk Unggulan
   Tabel dibawah ini merupakan kriteria yang di pertimbangkan dalam memilih komoditas/produk unggulan daerah. Untuk melakukan pembobotan kritera diperlukan tingkat kepentingan antar kriteria yang sudah ditentukan.

   Petunjuk Pengisian: Berikan tanda (√) pada angka kepentingan kriteria.

   0: Sama Penting, 1: Sedikit Lebih Penting, 2: Antara (1) dan (3),

   3: Lebih Penting, 4: Antara (3) dan (5), 5: Sangat Lebih Penting

Kriteria	5	4	3	2	1	0	1	2	3	4	5	Kriteria
Penggerak Perekonomian					√							Keterkaitan Antar Komoditas
Penggerak Perekonomian						√						*Competitiveness*
Penggerak Perekonomian,			√									Keterkaitan Dengan Daerah Lain
Penggerak Perekonomian			√									Status Teknologi
Penggerak Perekonomian						√						Penyerapan Tenaga Kerja
Penggerak Perekonomian						√						Prospek Komoditas
Penggerak Perekonomian						√						Stabilitas Terhadap Gejolak
Penggerak Perekonomian						√						Dukungan Sosial & Budaya

Kriteria	5	4	3	2	1	0	1	2	3	4	5	Kriteria
Competitiveness			√									Keterkaitan Dengan Daerah Lain
Competitiveness			√									Status Teknologi
Competitiveness						√						Penyerapan Tenaga Kerja
Competitiveness						√						Prospek Komoditas
Competitiveness						√						Stabilitas Terhadap Gejolak
Competitiveness						√						Dukungan Sosial & Budaya

Kriteria	5	4	3	2	1	0	1	2	3	4	5	Kriteria
Keterkaitan Dengan Daerah Lain						√						Status Teknologi
Keterkaitan Dengan Daerah Lain									√			Penyerapan Tenaga Kerja
Keterkaitan Dengan Daerah Lain									√			Prospek Komoditas
Keterkaitan Dengan Daerah Lain									√			Stabilitas Terhadap Gejolak
Keterkaitan Dengan Daerah Lain									√			Dukungan Sosial & Budaya

Kriteria	5	4	3	2	1	0	1	2	3	4	5	Kriteria
Status Teknologi									√			Penyerapan Tenaga Kerja
Status Teknologi									√			Prospek Komoditas
Status Teknologi									√			Stabilitas Terhadap Gejolak
Status Teknologi									√			Dukungan Sosial & Budaya

Kriteria	5	4	3	2	1	0	1	2	3	4	5	Kriteria
Penyerapan Tenaga Kerja						√						Prospek Komoditas
Penyerapan Tenaga Kerja						√						Stabilitas Terhadap Gejolak
Penyerapan Tenaga Kerja			√									Dukungan Sosial & Budaya

Kriteria	5	4	3	2	1	0	1	2	3	4	5	Kriteria
Prospek Komoditas						√						Stabilitas Terhadap Gejolak
Prospek Komoditas			√									Dukungan Sosial & Budaya

Kriteria	5	4	3	2	1	0	1	2	3	4	5	Kriteria
Stabilitas Terhadap Gejolak			√									Dukungan Sosial & Budaya

Kriteria	5	4	3	2	1	0	1	2	3	4	5	Kriteria
Keterkaitan Antar Komoditas								√				*Competitiveness*
Keterkaitan Antar Komoditas				√								Keterkaitan Dengan Daerah Lain
Keterkaitan Antar Komoditas				√								Status Teknologi
Keterkaitan Antar Komoditas					√							Penyerapan Tenaga Kerja
Keterkaitan Antar Komoditas							√					Prospek Komoditas
Keterkaitan Antar Komoditas				√								Stabilitas Terhadap Gejolak
Keterkaitan Antar Komoditas						√						Dukungan Sosial & Budaya

Jurusan Teknik Industri – Fakultas Teknik Industri
Institut Teknologi Sepuluh Nopember
Jl. Raya ITS, Keputih, Sukolilo, Kota Surabaya, Jawa Timur

2. Kuisioner Penilaian Produk Unggulan

Pada tabel dibawah merupakan tabel penilaian produk/komoditas terhadap kriteria produk unggulan. Penilaian produk terhadap kritera akan menjadi tolak ukur dalam pengambilan keputusan produk unggulan di daerah Boyolali.

Petunjuk Pengisian: Berikan tanda (√) nilai prodok/komoditas terhadap kriteria komoditas/ produk.

1: Tidak Baik, 2: Kurang Baik, 3: Cukup Baik, 4: Baik, 5: Sangat Baik

Sektor Pertanian

Komoditas	Kriteria Komoditas	Nilai				
		1	2	3	4	5
 Padi Ladang	Penggerak Perekonomian				√	
	Keterkaitan Dengan Komoditas Lain			√		
	Competitiveness			√		
	Keterkaitan Dengan Daerah Lain			√		
	Status Teknologi			√		
	Penyerapan Tenaga Kerja				√	
	Prospek Komoditas			√		
	Stabilitas Terhadap Gejolak			√		
	Dukungan Lingkungan & Budaya					√

Komoditas	Kriteria Komoditas	Nilai				
		1	2	3	4	5
 Jagung	Penggerak Perekonomian				√	
	Keterkaitan Dengan Komoditas Lain			√		
	Competitiveness			√		
	Keterkaitan Dengan Daerah Lain				√	
	Status Teknologi			√		
	Penyerapan Tenaga Kerja				√	
	Prospek Komoditas			√		
	Stabilitas Terhadap Gejolak			√		
	Dukungan Lingkungan & Budaya					√

Komoditas	Kriteria Komoditas	Nilai				
		1	2	3	4	5
 Cabe	Penggerak Perekonomian					√
	Keterkaitan Dengan Komoditas Lain				√	
	Competitiveness				√	
	Keterkaitan Dengan Daerah Lain			√		
	Status Teknologi			√		
	Penyerapan Tenaga Kerja				√	
	Prospek Komoditas					√
	Stabilitas Terhadap Gejolak			√		
	Dukungan Lingkungan & Budaya				√	

Komoditas	Kriteria Komoditas	Nilai				
		1	2	3	4	5
 Labu Siam	Penggerak Perekonomian			√		
	Keterkaitan Dengan Komoditas Lain			√		
	Competitiveness			√		
	Keterkaitan Dengan Daerah Lain			√		
	Status Teknologi			√		
	Penyerapan Tenaga Kerja				√	
	Prospek Komoditas				√	
	Stabilitas Terhadap Gejolak			√		
	Dukungan Lingkungan & Budaya				√	

Komoditas	Kriteria Komoditas	Nilai				
		1	2	3	4	5
 Alpukat	Penggerak Perekonomian					√
	Keterkaitan Dengan Komoditas Lain			√		
	Competitiveness				√	
	Keterkaitan Dengan Daerah Lain			√		
	Status Teknologi			√		
	Penyerapan Tenaga Kerja				√	
	Prospek Komoditas					√
	Stabilitas Terhadap Gejolak			√		
	Dukungan Lingkungan & Budaya				√	

Jurusan Teknik Industri – Fakultas Teknik Industri
Institut Teknologi Sepuluh Nopember
Jl. Raya ITS, Keputih, Sukolilo, Kota Surabaya, Jawa Timur

Komoditas	Kriteria Komoditas	Nilai				
		1	2	3	4	5
 Pepaya	Penggerak Perekonomian					✓
	Keterkaitan Dengan Komoditas Lain			✓		
	Competitiveness				✓	
	Keterkaitan Dengan Daerah Lain			✓		
	Status Teknologi				✓	
	Penyerapan Tenaga Kerja				✓	
	Prospek Komoditas				✓	
	Stabilitas Terhadap Gejolak			✓		
	Dukungan Lingkungan & Budaya					✓

Komoditas	Kriteria Komoditas	Nilai				
		1	2	3	4	5
 Kencur	Penggerak Perekonomian				✓	
	Keterkaitan Dengan Komoditas Lain			✓		
	Competitiveness				✓	
	Keterkaitan Dengan Daerah Lain				✓	
	Status Teknologi				✓	
	Penyerapan Tenaga Kerja				✓	
	Prospek Komoditas				✓	
	Stabilitas Terhadap Gejolak			✓		
	Dukungan Lingkungan & Budaya					✓

Komoditas	Kriteria Komoditas	Nilai				
		1	2	3	4	5
 Ternak Sapi Perah	Penggerak Perekonomian					✓
	Keterkaitan Dengan Komoditas Lain			✓		
	Competitiveness				✓	
	Keterkaitan Dengan Daerah Lain				✓	
	Status Teknologi				✓	
	Penyerapan Tenaga Kerja				✓	
	Prospek Komoditas				✓	
	Stabilitas Terhadap Gejolak			✓		
	Dukungan Lingkungan & Budaya					✓

Jurusan Teknik Industri – Fakultas Teknik Industri
Institut Teknologi Sepuluh Nopember
Jl. Raya ITS, Keputih, Sukolilo, Kota Surabaya, Jawa Timur

Komoditas	Kriteria Komoditas	Nilai				
		1	2	3	4	5
 Ternak Burung Puyuh	Penggerak Perekonomian				✓	
	Keterkaitan Dengan Komoditas Lain			✓		
	Competitiveness				✓	
	Keterkaitan Dengan Daerah Lain				✓	
	Status Teknologi				✓	
	Penyerapan Tenaga Kerja				✓	
	Prospek Komoditas				✓	
	Stabilitas Terhadap Gejolak				✓	
	Dukungan Lingkungan & Budaya					✓

Komoditas	Kriteria Komoditas	Nilai				
		1	2	3	4	5
 Telur Puyuh	Penggerak Perekonomian				✓	
	Keterkaitan Dengan Komoditas Lain			✓		
	Competitiveness			✓		
	Keterkaitan Dengan Daerah Lain			✓		
	Status Teknologi			✓		
	Penyerapan Tenaga Kerja				✓	
	Prospek Komoditas				✓	
	Stabilitas Terhadap Gejolak				✓	
	Dukungan Lingkungan & Budaya					✓

Komoditas	Kriteria Komoditas	Nilai				
		1	2	3	4	5
 Susu Sapi	Penggerak Perekonomian					✓
	Keterkaitan Dengan Komoditas Lain			✓		
	Competitiveness				✓	
	Keterkaitan Dengan Daerah Lain				✓	
	Status Teknologi				✓	
	Penyerapan Tenaga Kerja				✓	
	Prospek Komoditas				✓	
	Stabilitas Terhadap Gejolak			✓		
	Dukungan Lingkungan & Budaya					✓

Jurusan Teknik Industri – Fakultas Teknik Industri
Institut Teknologi Sepuluh Nopember
Jl. Raya ITS, Keputih, Sukolilo, Kota Surabaya, Jawa Timur

Sektor Industri Olahan

Komoditas	Kriteria Komoditas	Nilai				
		1	2	3	4	5
 Industri Makanan	Penggerak Perekonomian					√
	Keterkaitan Dengan Komoditas Lain					√
	Competitiveness					√
	Keterkaitan Dengan Daerah Lain					√
	Status Teknologi					√
	Penyerapan Tenaga Kerja					√
	Prospek Komoditas					√
	Stabilitas Terhadap Gejolak			√		
	Dukungan Lingkungan & Budaya					√

Komoditas	Kriteria Komoditas	Nilai				
		1	2	3	4	5
 Industri Tembakau	Penggerak Perekonomian				√	
	Keterkaitan Dengan Komoditas Lain					√
	Competitiveness				√	
	Keterkaitan Dengan Daerah Lain				√	
	Status Teknologi				√	
	Penyerapan Tenaga Kerja				√	
	Prospek Komoditas				√	
	Stabilitas Terhadap Gejolak			√		
	Dukungan Lingkungan & Budaya					√

Komoditas	Kriteria Komoditas	Nilai				
		1	2	3	4	5
 Industri Barang Kayu dan Anyaman	Penggerak Perekonomian				√	
	Keterkaitan Dengan Komoditas Lain					√
	Competitiveness				√	
	Keterkaitan Dengan Daerah Lain				√	
	Status Teknologi				√	
	Penyerapan Tenaga Kerja				√	
	Prospek Komoditas				√	
	Stabilitas Terhadap Gejolak			√		
	Dukungan Lingkungan & Budaya					√

Jurusan Teknik Industri – Fakultas Teknik Industri
Institut Teknologi Sepuluh Nopember
Jl. Raya ITS, Keputih, Sukolilo, Kota Surabaya, Jawa Timur

Komoditas	Kriteria Komoditas	Nilai				
		1	2	3	4	5
 Industri Furniture	Penggerak Perekonomian				√	
	Keterkaitan Dengan Komoditas Lain					√
	Competitiveness				√	
	Keterkaitan Dengan Daerah Lain				√	
	Status Teknologi					√
	Penyerapan Tenaga Kerja				√	
	Prospek Komoditas				√	
	Stabilitas Terhadap Gejolak			√		
	Dukungan Lingkungan & Budaya					√

Komoditas	Kriteria Komoditas	Nilai				
		1	2	3	4	5
 Industri Barang Logam	Penggerak Perekonomian					√
	Keterkaitan Dengan Komoditas Lain		√			
	Competitiveness				√	
	Keterkaitan Dengan Daerah Lain			√		
	Status Teknologi					√
	Penyerapan Tenaga Kerja				√	
	Prospek Komoditas				√	
	Stabilitas Terhadap Gejolak		√			
	Dukungan Lingkungan & Budaya		√			

Boyolali, Juni 2016

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B. Criteria Weighing Appraisal by Expert

Gunawan A. (Bappeda)

	Economic Driver	Comodity Relativeness	Competitiveness	Region Relativeness	State of Technology	Employement	Prospect	Stability	Environment & Culture
Bappeda 1	17	14	9	3	3	30	13	4	7
Calculated Wei	16.958	14.181	8.540	3.414	2.855	29.591	12.867	4.420	7.174
Economic Drive	1.00	4.00	0.25	0.25	0.17	2.00	0.25	0.20	0.50
Comodity Rela	0.25	1.00	0.50	1.00	0.25	4.00	1.00	0.33	0.25
Competitivene	4.00	2.00	1.00	0.25	0.50	3.00	3.00	0.33	0.33
Region Relative	4.00	1.00	4.00	1.00	1.00	4.00	4.00	3.00	5.00
State of Techno	6.00	4.00	2.00	1.00	1.00	5.00	4.00	4.00	5.00
Employement	0.50	0.25	0.33	0.25	0.20	1.00	0.17	0.20	0.20
Prospect	4.00	1.00	0.33	0.25	0.25	6.00	1.00	0.25	0.20
Stability	5.00	3.00	3.00	0.33	0.25	5.00	4.00	1.00	5.00
Environment &	2.00	4.00	3.00	0.20	0.20	5.00	5.00	0.20	1.00

Sarangat S.H (Bappeda)

	Economic Driver	Comodity Relativeness	Competitiveness	Region Relativeness	State of Technology	Employement	Prospect	Stability	Environment & Culture
Bappeda2	7	8	16	7	10	15	17	12	8
Calculated Wei	6.811	7.945	16.099	6.596	10.471	14.712	16.841	12.215	8.311
Economic Drive	1.00	1.00	4.00	1.00	2.00	2.00	1.00	1.00	3.00
Comodity Rela	1.00	1.00	1.00	1.00	0.50	4.00	3.00	4.00	0.50
Competitivene	0.25	1.00	1.00	1.00	1.00	0.50	0.50	1.00	0.33
Region Relative	1.00	1.00	1.00	1.00	1.00	4.00	4.00	4.00	1.00
State of Techno	0.50	2.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Employement	0.50	0.25	2.00	0.25	1.00	1.00	3.00	0.50	0.50
Prospect	1.00	0.33	2.00	0.25	1.00	0.33	1.00	0.50	0.50
Stability	1.00	0.25	1.00	0.25	1.00	2.00	2.00	1.00	1.00
Environment &	0.33	2.00	3.00	1.00	1.00	2.00	2.00	1.00	1.00

Sasongko P. (Bappeda)

	Economic Driver	Comodity Relativeness	Competitiveness	Region Relativeness	State of Technology	Employement	Prospect	Stability	Environment & Culture
Bappeda3	8	8	14	6	10	12	20	15	7
Calculated Wei	7.777	7.833	14.048	6.136	10.323	11.663	19.997	15.372	6.852
Economic Drive	1.00	1.00	1.00	1.00	2.00	2.00	4.00	4.00	0.20
Comodity Rela	1.00	1.00	1.00	1.00	2.00	2.00	0.50	3.00	2.00
Competitivene	1.00	1.00	1.00	0.25	0.25	0.25	4.00	1.00	1.00
Region Relative	1.00	1.00	4.00	1.00	1.00	3.00	3.00	3.00	1.00
State of Techno	0.50	0.50	4.00	1.00	1.00	1.00	1.00	1.00	1.00
Employement	0.50	0.50	4.00	0.33	1.00	1.00	1.00	1.00	1.00
Prospect	0.25	2.00	0.25	0.33	1.00	1.00	1.00	0.25	0.25
Stability	0.25	0.33	1.00	0.33	1.00	1.00	4.00	1.00	0.25
Environment &	5.00	0.50	1.00	1.00	1.00	1.00	4.00	4.00	1.00

Sasongko P. (Distanbunhut)

	Economic Driver	Comodity Relativeness	Competitiveness	Region Relativeness	State of Technology	Employement	Prospect	Stability	Environment & Culture
Disperhutanbu	14	11	15	3	3	14	17	14	8
Calculated Wei	14.217	11.432	14.872	3.398	3.398	14.217	16.584	13.590	8.292
Economic Drive	1.00	0.50	1.00	0.25	0.25	1.00	1.00	1.00	1.00
Comodity Rela	2.00	1.00	3.00	0.33	0.33	0.50	2.00	0.33	1.00
Competitivene	1.00	0.33	1.00	0.25	0.25	1.00	1.00	1.00	1.00
Region Relative	4.00	3.00	4.00	1.00	1.00	4.00	4.00	4.00	4.00
State of Techno	4.00	3.00	4.00	1.00	1.00	4.00	4.00	4.00	4.00
Employement	1.00	2.00	1.00	0.25	0.25	1.00	1.00	1.00	0.25
Prospect	1.00	0.50	1.00	0.25	0.25	1.00	1.00	1.00	0.25
Stability	1.00	3.00	1.00	0.25	0.25	1.00	1.00	1.00	0.25
Environment &	1.00	1.00	1.00	0.25	0.25	4.00	4.00	4.00	1.00

Ibnu Sutopo (Distanbunhut)

	Economic Driver	Comodity Relativeness	Competitiveness	Region Relativeness	State of Technology	Employement	Prospect	Stability	Environment & Culture
Disperhutanbu	14	9	10	7	12	18	10	7	12
Calculated Wei	13.719	9.444	10.009	7.496	12.197	17.718	10.335	6.634	12.447
Economic Drive	1.00	4.00	1.00	0.50	5.00	0.50	0.25	0.25	0.33
Comodity Rela	0.25	1.00	3.00	2.00	0.50	4.00	1.00	1.00	1.00
Competitivene	1.00	0.33	1.00	0.33	4.00	2.00	3.00	0.33	2.00
Region Relative	2.00	0.50	3.00	1.00	2.00	4.00	2.00	0.50	1.00
State of Techno	0.20	2.00	0.25	0.50	1.00	2.00	2.00	0.50	3.00
Employement	2.00	0.25	0.50	0.25	0.50	1.00	0.17	2.00	1.00
Prospect	4.00	1.00	0.33	0.50	0.50	6.00	1.00	0.33	2.00
Stability	4.00	1.00	3.00	2.00	2.00	0.50	3.00	1.00	1.00
Environment &	3.00	1.00	0.50	1.00	0.33	1.00	0.50	1.00	1.00

Satriyo W (Distanbunhut)

	Economic Driver	Comodity Relativeness	Competitiveness	Region Relativeness	State of Technology	Employement	Prospect	Stability	Environment & Culture
Disperhutanbu	15	8	16	5	4	7	22	7	16
Calculated Wei	14.712	8.469	15.890	5.335	4.048	6.597	21.908	6.635	16.406
Economic Drive	1.00	0.33	1.00	0.50	0.25	0.25	3.00	0.33	2.00
Comodity Rela	3.00	1.00	2.00	0.33	0.33	3.00	3.00	0.50	1.00
Competitivene	1.00	0.50	1.00	1.00	0.25	0.25	1.00	0.33	1.00
Region Relative	2.00	3.00	1.00	1.00	0.33	3.00	4.00	2.00	4.00
State of Techno	4.00	3.00	4.00	3.00	1.00	1.00	4.00	1.00	4.00
Employement	4.00	0.33	4.00	0.33	1.00	1.00	4.00	1.00	4.00
Prospect	0.33	0.33	1.00	0.25	0.25	0.25	1.00	0.33	1.00
Stability	3.00	2.00	3.00	0.50	1.00	1.00	3.00	1.00	1.00
Environment &	0.50	1.00	1.00	0.25	0.25	0.25	1.00	1.00	1.00

Sriharyanti (Distanbunhut)

	Economic Driver	Comodity Relativeness	Competitiveness	Region Relativeness	State of Technology	Employement	Prospect	Stability	Environment & Culture
Disperhutanbu	12	8	15	10	12	12	16	8	6
Calculated Wei	11.563	8.498	14.569	9.913	11.563	12.489	16.460	8.498	6.447
Economic Drive	1.00	0.50	1.00	0.50	2.00	1.00	3.00	1.00	0.33
Comodity Rela	2.00	1.00	2.00	1.00	1.00	2.00	2.00	0.50	1.00
Competitivene	1.00	0.50	1.00	1.00	1.00	0.50	1.00	0.50	0.50
Region Relative	2.00	1.00	1.00	1.00	1.00	2.00	2.00	0.50	0.50
State of Techno	0.50	1.00	1.00	1.00	1.00	1.00	2.00	1.00	0.50
Employement	1.00	0.50	2.00	0.50	1.00	1.00	1.00	1.00	0.50
Prospect	0.33	0.50	1.00	0.50	0.50	1.00	1.00	1.00	0.50
Stability	1.00	2.00	2.00	2.00	1.00	1.00	1.00	1.00	1.00
Environment &	3.00	1.00	2.00	2.00	2.00	2.00	2.00	1.00	1.00

Sri Haryono (Disperindag)

	Economic Driver	Comodity Relativeness	Competitiveness	Region Relativeness	State of Technology	Employement	Prospect	Stability	Environment & Culture
Disperindag1	20	20	6	13	10	13	6	6	5
Calculated Wei	19.602	20.266	6.337	12.749	9.561	13.451	6.337	6.263	5.432
Economic Drive	1.00	3.00	1.00	0.25	0.25	0.20	0.33	0.33	0.50
Comodity Rela	0.33	1.00	0.50	0.33	0.33	3.00	0.33	0.25	0.33
Competitivene	1.00	2.00	1.00	1.00	2.00	3.00	3.00	3.00	0.50
Region Relative	4.00	3.00	1.00	1.00	0.25	1.00	0.33	0.20	0.50
State of Techno	4.00	3.00	0.50	4.00	1.00	0.50	0.33	1.00	0.33
Employement	5.00	0.33	0.33	1.00	2.00	1.00	0.50	0.33	0.33
Prospect	3.00	3.00	0.33	3.00	3.00	2.00	1.00	1.00	1.00
Stability	3.00	4.00	0.33	5.00	1.00	3.00	1.00	1.00	1.00
Environment &	2.00	3.00	2.00	2.00	3.00	3.00	1.00	1.00	1.00

Agus Supriyadi (Disperindag)

	Economic Driver	Comodity Relativeness	Competitiveness	Region Relativeness	State of Technology	Employement	Prospect	Stability	Environment & Culture
Disperindag2	23	13	13	5	5	17	6	8	10
Calculated Wei	22.972	13.224	12.642	5.017	4.734	17.430	6.321	7.815	9.846
Economic Drive	1.00	0.25	0.33	0.33	0.50	0.50	0.50	0.25	0.50
Comodity Rela	4.00	1.00	0.50	0.50	0.50	1.00	0.50	0.50	0.50
Competitivene	3.00	2.00	1.00	0.50	0.50	0.50	0.50	0.50	0.50
Region Relative	3.00	2.00	2.00	1.00	2.00	2.00	2.00	2.00	2.00
State of Techno	2.00	2.00	2.00	0.50	1.00	6.00	3.00	3.00	3.00
Employement	2.00	1.00	2.00	0.50	0.17	1.00	0.25	0.25	0.25
Prospect	2.00	2.00	2.00	0.50	0.33	4.00	1.00	3.00	3.00
Stability	4.00	2.00	2.00	0.50	0.33	4.00	0.33	1.00	2.00
Environment &	2.00	2.00	2.00	0.50	0.33	4.00	0.33	0.50	1.00

Sri Handayani (Disperindag)

	Economic Driver	Comodity Relativeness	Competitiveness	Region Relativeness	State of Technology	Employement	Prospect	Stability	Environment & Culture
Disperindag3	17	20	9	12	7	10	9	8	8
Calculated Wei	16.823	20.117	9.258	11.818	7.499	10.131	8.572	8.194	7.587
Economic Drive	1.00	5.00	1.00	0.50	0.20	0.17	0.17	1.00	1.00
Comodity Rela	0.20	1.00	3.00	0.50	0.33	1.00	0.33	0.25	0.33
Competitivene	1.00	0.33	1.00	1.00	1.00	3.00	6.00	1.00	0.50
Region Relative	2.00	2.00	1.00	1.00	0.25	1.00	3.00	0.33	0.33
State of Techno	5.00	3.00	1.00	4.00	1.00	1.00	0.33	2.00	0.50
Employement	6.00	1.00	0.33	1.00	1.00	1.00	1.00	0.33	2.00
Prospect	6.00	3.00	0.17	0.33	3.00	1.00	1.00	2.00	1.00
Stability	1.00	4.00	1.00	3.00	0.50	3.00	0.50	1.00	1.00
Environment &	1.00	3.00	2.00	3.00	2.00	0.50	1.00	1.00	1.00

C. ELECTRE Method Calculation

Attachment 2. 1 Alternative Appraisal

	Economy Driver	Other Comodity Relativeness	Competitive ness	Other Region Relativeness	State of Technology	Employeme nt	Comodity Prospect	Stability to Fluctiation	Environmen t & Culture Support
Wet Rice	4.6	3.7	3.7	3.4	3.4	3.9	4.2	3.2	4.2
Corn	4.1	3.6	3.8	3.5	3.1	3.7	3.8	2.9	3.9
Chili	3.9	3.7	3.5	3.4	2.8	3.6	4	2.5	3.4
Chayote	3.2	3.1	3.1	2.7	2.6	3	3.5	2.6	3
Avocado	3.5	3.3	3.3	3	2.5	2.6	3.5	2.6	3
Papaya	3.9	3.3	3.4	3.2	3.5	3.7	3.9	3.3	3.9
Kencur	3.9	3.3	3.3	3.3	3.4	3.5	3.9	3.4	3.8
Diary Cows Farmery	4.6	3.8	3.8	4	3.5	4.3	4.4	3.8	4.2
Quail Bird Farmery	3.1	2.9	3	2.8	3	2.9	3	2.6	2.9
Quail Bird Egg	3.4	3	3.1	2.9	2.8	2.8	3.3	2.5	3
Cow's Milk	4.6	3.7	4	3.7	3.7	3.8	4.4	3.2	3.8
Tobacco Industry	4.2	3.6	3.5	3.5	3.5	4	3.9	2.9	3.6
Wood Goods & Webbing Industry	3.6	3.4	3.4	3.4	3.4	3.8	3.5	3.4	3.7
Furniture Industry	3.9	4.1	3.7	3.7	4.3	4.2	4.1	3.6	3.8
Metal Goods Industry	4.2	3.5	3.8	3.7	4.4	4	3.8	3.6	3.6

Normalizing Matrix

$$r_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{m} x_{ij}^2}} \; for\; i = 1,2,3,..,m \; and \; j = 1,2,3,..,n$$

Attachment 2. 2 Normalized Matrix

Normalized Matrix	Economy Driver	Other Comodity Relativeness	Competitive ness	Other Region Relativeness	State of Technology	Employeme nt	Comodity Prospect	Stability to Fluctiation	Environmen t & Culture Support
Wet Rice	0.301	0.274	0.273	0.261	0.261	0.278	0.283	0.266	0.300
Corn	0.269	0.267	0.280	0.269	0.238	0.264	0.256	0.241	0.279
Chili	0.255	0.274	0.258	0.261	0.215	0.257	0.269	0.208	0.243
Chayote	0.210	0.230	0.228	0.207	0.199	0.214	0.236	0.216	0.215
Avocado	0.229	0.245	0.243	0.230	0.192	0.185	0.236	0.216	0.215
Papaya	0.255	0.245	0.250	0.245	0.268	0.264	0.263	0.275	0.279
Kencur	0.255	0.245	0.243	0.253	0.261	0.249	0.263	0.283	0.272
Diary Cows Farmery	0.301	0.282	0.280	0.307	0.268	0.307	0.296	0.316	0.300
Quail Bird Farmery	0.203	0.215	0.221	0.215	0.230	0.207	0.202	0.216	0.207
Quail Bird Egg	0.223	0.223	0.228	0.222	0.215	0.200	0.222	0.208	0.215
Cow's Milk	0.301	0.274	0.295	0.284	0.284	0.271	0.296	0.266	0.272
Tobacco Industry	0.275	0.267	0.258	0.269	0.268	0.285	0.263	0.241	0.257
Wood Goods & Webbing Industry	0.236	0.252	0.250	0.261	0.261	0.271	0.236	0.283	0.265
Furniture Industry	0.255	0.304	0.273	0.284	0.330	0.299	0.276	0.300	0.272
Metal Goods Industry	0.275	0.260	0.280	0.284	0.337	0.285	0.256	0.300	0.257

Normalized Matrix Weighing

$V = R\ x\ W$

Attachment 2. 3 Weighted Normalized Matrix

Criteria Weight	14.7	11.9	*12.3*	7.2	7.6	14.8	13.7	9	8.8
Weighted Normalized Matrix	Economy Driver	Other Comodity Relativeness	Competitiveness	Other Region Relativeness	State of Technology	Employement	Comodity Prospect	Stability to Fluctiation	Environment & Culture Support
Wet Rice	4.430	3.266	3.352	1.878	1.980	4.114	3.877	2.396	2.643
Corn	3.948	3.178	3.443	1.933	1.806	3.903	3.507	2.172	2.454
Chili	3.756	3.266	3.171	1.878	1.631	3.798	3.692	1.872	2.139
Chayote	3.081	2.736	2.809	1.491	1.514	3.165	3.230	1.947	1.888
Avocado	3.370	2.913	2.990	1.657	1.456	2.743	3.230	1.947	1.888
Papaya	3.756	2.913	3.080	1.768	2.039	3.903	3.600	2.471	2.454
Kencur	3.756	2.913	2.990	1.823	1.980	3.692	3.600	2.546	2.391
Diary Cows Farmery	4.430	3.354	3.443	2.209	2.039	4.536	4.061	2.846	2.643
Quail Bird Farmery	2.985	2.560	2.718	1.547	1.747	3.059	2.769	1.947	1.825
Quail Bird Egg	3.274	2.648	2.809	1.602	1.631	2.954	3.046	1.872	1.888
Cow's Milk	4.430	3.266	3.624	2.044	2.155	4.009	4.061	2.396	2.391
Tobacco Industry	4.044	3.178	3.171	1.933	2.039	4.220	3.600	2.172	2.265
Wood Goods & Webbing Industry	3.467	3.001	3.080	1.878	1.980	4.009	3.230	2.546	2.328
Furniture Industry	3.756	3.619	3.352	2.044	2.504	4.431	3.784	2.696	2.391
Metal Goods Industry	4.044	3.090	3.443	2.044	2.563	4.220	3.507	2.696	2.265

Concordance and Discordance Sets Determination

The sets of concordance for alternative 1 is,

$$C_{12} = \{1,2,5,6,7,8,9\}$$
$$C_{13} = \{1,2,3,4,5,6,7,8,9\}$$
$$C_{14} = \{1,2,3,4,5,6,7,8,9\}$$
$$C_{15} = \{\{1,2,3,4,5,6,7,8,9\}\}$$
$$C_{16} = \{1.2.4.6.7.9\}$$
$$C_{17} = \{1,2,3,4,5,6,7,9\}$$
$$C_{18} = \{1,9\}$$
$$C_{19} = \{\{1,2,3,4,5,6,7,8,9\}\}$$
$$C_{110} = \{\{1,2,3,4,5,6,7,8,9\}\}$$
$$C_{111} = \{1,2,6,8,9\}$$
$$C_{112} = \{1,2,3,7,8,9\}$$
$$C_{113} = \{,1,2,3,4,5,6,7,9\}$$
$$C_{114} = \{1,3,7,9\}$$
$$C_{115} = \{1,2,7,9\}$$

The sets of concordance for alternative 2 is,

$$C_{21} = \{3,4\}$$
$$C_{23} = \{1,3,4,5,6,8,9\}$$
$$C_{24} = \{\{1,2,3,4,5,6,7,9\}\}$$
$$C_{29} = \{\{1,2,3,4,5,6,7,9\}\}$$
$$C_{210} = \{\{1,2,3,4,5,6,7,9\}\}$$
$$C_{211} = \{9\}$$

$C_{25} = \{\{1,2,3,4,5,6,7,9\}\}$ $C_{212} = \{2,3,4,8,9\}$

$C_{26} = \{1,2,3,4,6,9\}$ $C_{213} = \{1,2,3,4,7,9\}$

$C_{27} = \{1,2,3,4,6,9\}$ $C_{214} = \{1,3,9\}$

$C_{28} = \{3\}$ $C_{215} = \{2,3,7,9\}$

The sets of concordance for alternative 3 is,

$C_{31} = \{2,4\}$ $C_{39} = \{1,2,3,4,6,7,9\}$

$C_{32} = \{2,7\}$ $C_{310} = \{1,2,3,4,5,6,7,8,9\}$

$C_{34} = \{1,2,3,4,5,6,7,9\}$ $C_{311} = \{2\}$

$C_{35} = \{1,2,3,4,5,6,7,9\}$ $C_{312} = \{2,3,7\}$

$C_{36} = \{1,2,3,4,7\}$ $C_{313} = \{1,2,3,4,7\}$

$C_{37} = \{1,2,3,4,6,7\}$ $C_{314} = \{1\}$

$C_{38} = \{\ \}$ $C_{315} = \{2,7\}$

The sets of concordanc3e for alternative 4 is,

$C_{41} = \{\ \}$ $C_{49} = \{1,2,3,6,7,8,9\}$

$C_{42} = \{\ \}$ $C_{410} = \{2,3,6,7,8,9\}$

$C_{43} = \{8\}$ $C_{411} = \{\ \}$

$C_{45} = \{1,2,3,4,5,6,7,8,9\}$ $C_{412} = \{\ \}$

$C_{46} = \{\ \}$ $C_{413} = \{7\}$

$C_{47} = \{\ \}$ $C_{414} = \{\ \}$

$C_{48} = \{\ \}$ $C_{415} = \{\ \}$

The sets of concordance for alternative 5 is,

$C_{51} = \{\ \}$ $C_{59} = \{1,2,3,4,7,8,9\}$

$C_{52} = \{\ \}$ $C_{510} = \{1,2,3,4,7,8,9\}$

$C_{53} = \{8\}$ $C_{511} = \{\ \}$

$C_{54} = \{1,2,3,4,7,8,9\}$ $C_{512} = \{\ \}$

$C_{56} = \{2\}$ $C_{513} = \{7\}$

$C_{57} = \{2,3\}$ $C_{514} = \{\ \}$

$C_{58} = \{\ \}$ $C_{515} = \{\ \}$

The sets of concordance for alternative 6 is,

$C_{61} = \{5,8\}$ $C_{69} = \{1,2,3,4,5,6,7,8,9\}$

$C_{62} = \{5,6,7,8,9\}$ $C_{610} = \{1,2,3,4,5,6,7,8,9\}$

$C_{63} = \{1,5,6,8,9\}$ $C_{611} = \{8,9\}$

$C_{64} = \{1,2,3,4,5,6,7,8,9\}$ $C_{612} = \{5,7,8,9\}$

$C_{65} = \{1,2,3,4,5,6,7,8,9\}$ $C_{613} = \{1,3,5,7,9\}$

$C_{67} = \{1,2,3,5,6,7,9\}$ $C_{614} = \{1,9\}$

$C_{68} = \{5\}$ $C_{615} = \{7,9\}$

The sets of concor6dance for alternative 7 is,

$C_{71} = \{5,8\}$ $C_{79} = \{1,2,3,4,5,6,7,8,9\}$

$C_{72} = \{5,7,8\}$ $C_{710} = \{1,2,3,4,5,6,7,8,9\}$

$C_{73} = \{1,5,8,9\}$ $C_{711} = \{8,9\}$

$C_{74} = \{1,2,3,4,5,6,7,8,9\}$ $C_{712} = \{7,8,9\}$

$C_{75} = \{1,2,3,4,5,6,7,8,9\}$ $C_{713} = \{1,5,7,8,9\}$

$C_{76} = \{1,2,4,7,8\}$ $C_{714} = \{1,9\}$

$C_{78} = \{\ \}$ $C_{715} = \{7,9\}$

The sets of concordance for alternative 8 is,

$C_{81} = \{1,2,3,4,5,6,7,8,9\}$ $C_{89} = \{1,2,3,4,5,6,7,8,9\}$

$C_{82} = \{1,2,3,4,5,6,7,8,9\}$ $C_{810} = \{1,2,3,4,5,6,7,8,9\}$

$C_{83} = \{1,2,3,4,5,6,7,8,9\}$ $C_{811} = \{1,2,4,6,7,8,9\}$

$C_{84} = \{1,2,3,4,5,6,7,8,9\}$ $C_{812} = \{1,2,3,4,5,6,7,8,9\}$

$C_{85} = \{1,2,3,4,5,6,7,8,9\}$ $C_{813} = \{1,2,3,4,5,6,7,8,9\}$

$C_{86} = \{1,2,3,4,5,6,7,8,9\}$ $C_{814} = \{1,3,4,6,7,8,9\}$

$C_{87} = \{1,2,3,4,5,6,7,8,9\}$ $C_{815} = \{1,2,3,4,6,7,8,9\}$

The sets of concordance for alternative 9 is,

$C_{91} = \{\ \}$ $C_{98} = \{\ \}$

$C_{92} = \{\ \}$ $C_{910} = \{5,6,8\}$

$C_{93} = \{5,8\}$ $C_{911} = \{\ \}$

$C_{94} = \{4,5,8\}$ $C_{912} = \{\ \}$

$C_{95} = \{5,6,8\}$ $C_{913} = \{\ \}$

$C_{96} = \{\ \}$ $C_{914} = \{\ \}$

$C_{97} = \{\ \}$ $C_{915} = \{\ \}$

The sets of concordance for alternative 10 is,

$C_{101} = \{\ \}$ $C_{108} = \{\ \}$

$C_{102} = \{\ \}$ $C_{109} = \{1,2,3,4,7,9\}$

$C_{103} = \{5,8\}$ $C_{1011} = \{\ \}$

$C_{104} = \{1,3,4,5,9\}$ $C_{1012} = \{\ \}$

$C_{105} = \{5,6,9\}$ $C_{1013} = \{\ \}$

$C_{106} = \{\ \}$ $C_{1014} = \{\ \}$

$C_{107} = \{\ \}$ $C_{1015} = \{\ \}$

The sets of concordance for alternative 11 is,

$C_{111} = \{1,2,3,4,5,7,8\}$ $C_{118} = \{1,3,5,7\}$

$C_{112} = \{1,2,3,4,5,6,7,8\}$ $C_{119} = \{1,2,3,4,5,6,7,8,9\}$

$C_{113} = \{1,2,3,4,5,6,7,8,9\}$ $C_{1110} = \{1,2,3,4,5,6,7,8,9\}$

$C_{114} = \{1,2,3,4,5,6,7,8,9\}$ $C_{1112} = \{1,2,3,4,5,7,8,9\}$

$C_{115} = \{1,2,3,4,5,6,7,8,9\}$ $C_{1113} = \{1,2,3,4,5,6,7,9\}$

$C_{116} = \{1,2,3,4,5,6,7\}$ $C_{1114} = \{1,3,4,7,9\}$

$C_{117} = \{1,2,3,4,5,6,8,9\}$ $C_{1115} = \{1,2,3,4,7,9\}$

The sets of concordance for alternative 12 is,

$C_{121} = \{4,5,6\}$ $C_{128} = \{5\}$

$C_{122} = \{1,2,4,5,6,7,8\}$ $C_{129} = \{1,2,3,4,5,6,7,8,9\}$

$C_{123} = \{1,3,4,5,6,8,9\}$ $C_{1210} = \{1,2,3,4,5,6,7,8,9\}$

$C_{124} = \{1,2,3,4,5,6,7,8,9\}$ $C_{1211} = \{6\}$

$C_{125} = \{1,2,3,4,5,6,7,8,9\}$ $C_{1213} = \{1,2,3,4,5,6,7\}$

$C_{126} = \{1,2,3,4,5,6,7\}$ $C_{1214} = \{1\}$

$C_{127} = \{1,2,3,4,5,6,7\}$ $C_{1215} = \{1,2,6,7,9\}$

The sets of concordance for alternative 13 is,

$C_{131} = \{4,5,8\}$ $C_{138} = \{\ \}$

$C_{132} = \{5,6,8\}$ $C_{139} = \{1,2,3,4,5,6,7,8,9\}$

$C_{133} = \{4,5,6,8\}$ $C_{1310} = \{1,2,3,4,5,6,7,8,9\}$

$C_{134} = \{1,2,3,4,5,6,7,8,9\}$

$C_{135} = \{1,2,3,4,5,6,7,8,9\}$

$C_{136} = \{2,3,4,6,8\}$

$C_{137} = \{2,3,4,5,6,8\}$

$C_{1311} = \{6,8\}$

$C_{1312} = \{8,9\}$

$C_{1314} = \{\ \ \}$

$C_{1315} = \{9\}$

The sets of concordance for alternative 14 is,

$C_{141} = \{2,3,4,5,6,8\}$

$C_{142} = \{2,4,5,6,7,8\}$

$C_{143} = \{1,2,3,4,5,6,7,8,9\}$

$C_{144} = \{1,2,3,4,5,6,7,8,9\}$

$C_{145} = \{1,2,3,4,5,6,7,8,9\}$

$C_{146} = \{1,2,3,4,5,6,7,8\}$

$C_{147} = \{1,2,3,4,5,6,7,8,9\}$

$C_{148} = \{2,5\}$

$C_{149} = \{1,2,3,4,5,6,7,8,9\}$

$C_{1410} = \{1,2,3,4,5,6,7,8,9\}$

$C_{1411} = \{2,4,5,6,8,9\}$

$C_{1412} = \{2,3,4,5,6,7,8,9\}$

$C_{1413} = \{1,2,3,4,5,6,7,8,9\}$

$C_{1415} = \{2,4,6,7,8,9\}$

The sets of concordance for alternative 15 is,

$C_{151} = \{3,4,5,6,8\}$

$C_{152} = \{1,3,4,5,6,7,8\}$

$C_{153} = \{1,3,4,5,6,7,8,9\}$

$C_{154} = \{1,2,3,4,5,6,7,8,9\}$

$C_{155} = \{1,2,3,4,5,6,7,8,9\}$

$C_{156} = \{1,2,3,4,5,6,8\}$

$C_{157} = \{1,2,3,4,5,6,8\}$

$C_{158} = \{3,5\}$

$C_{159} = \{1,2,3,4,5,6,7,8,9\}$

$C_{1510} = \{1,2,3,4,5,6,7,8,9\}$

$C_{1511} = \{4,5,6,8\}$

$C_{1512} = \{1,3,4,5,6,8\}$

$C_{1513} = \{1,2,3,4,5,6,7,8\}$

$C_{1514} = \{1,3,4,5,8\}$

The sets of discordance for alternative 1 is,

$D_{12} = \{3,4\}$

$D_{13} = \{\ \ \}$

$D_{14} = \{\ \ \}$

$D_{15} = \{\ \ \}$

$D_{16} = \{5,8\}$

$D_{17} = \{8\}$

$D_{18} = \{2,3,4,5,6,7,8\}$

$D_{19} = \{\ \ \}$

$D_{110} = \{\ \ \}$

$D_{111} = \{3,4,5,7\}$

$D_{112} = \{4,5,6\}$

$D_{113} = \{8\}$

$D_{114} = \{2,4,5,6,8\}$

$D_{115} = \{3,4,5,6,8\}$

The sets of discordance for alternative 2 is,

$D_{21} = \{1,2,5,6,7,8,9\}$ $D_{29} = \{\ \}$

$D_{23} = \{2,7\}$ $D_{210} = \{\ \}$

$D_{24} = \{\ \}$ $D_{211} = \{1,2,3,4,5,6,7,8\}$

$D_{25} = \{\ \}$ $D_{212} = \{1,5,6,7\}$

$D_{26} = \{5,7,8\}$ $D_{213} = \{5,6,8\}$

$D_{27} = \{5,7,8\}$ $D_{214} = \{2,4,5,6,7,8\}$

$D_{28} = \{1,2,4,5,6,7,8,9\}$ $D_{215} = \{1,4,5,6,8\}$

The sets of discordance for alternative 3 is,

$D_{31} = \{1,3,5,6,7,8,9\}$ $D_{39} = \{5,8\}$

$D_{32} = \{1,3,4,5,6,8,9\}$ $D_{310} = \{\ \}$

$D_{34} = \{8\}$ $D_{311} = \{1,3,4,5,6,7,8,9\}$

$D_{35} = \{8\}$ $D_{312} = \{1,4,5,6,8,9\}$

$D_{36} = \{5,6,8,9\}$ $D_{313} = \{5,6,8,9\}$

$D_{37} = \{5,8,9\}$ $D_{314} = \{2,3,4,5,6,7,8,9\}$

$D_{38} = \{1,2,3,4,5,6,7,8,9\}$ $D_{315} = \{1,3,4,5,6,8,9\}$

The sets of concordanc3e for alternative 4 is,

$D_{41} = \{1,3,4,5,6,8,9\}$ $D_{49} = \{4,5\}$

$D_{42} = \{1,2,3,4,5,6,7,8,9\}$ $D_{410} = \{1,4,5\}$

$D_{43} = \{1,2,3,4,5,6,7,9\}$ $D_{411} = \{1,2,3,4,5,6,7,8,9\}$

$D_{45} = \{1,2,3,4\}$ $D_{412} = \{1,2,3,4,5,6,7,8,9\}$

$D_{46} = \{1,2,3,4,5,6,7,8,9\}$ $D_{413} = \{1,2,3,4,5,6,8,9\}$

$D_{47} = \{1,2,3,4,5,6,7,8,9\}$ $D_{414} = \{1,2,3,4,5,6,7,8,9\}$

$D_{48} = \{1,2,3,4,5,6,7,8,9\}$ $D_{415} = \{1,2,3,4,5,6,7,8,9\}$

The sets of discordance for alternative 5 is,

$D_{51} = \{1,2,3,4,5,6,7,8,9\}$ $D_{59} = \{5,6\}$

$D_{52} = \{1,2,3,4,5,6,7,8,9\}$ $D_{510} = \{5,6\}$

$D_{53} = \{1,2,3,4,5,6,7,9\}$ $D_{511} = \{1,2,3,4,5,6,7,8,9\}$

$D_{54} = \{5,6\}$ $D_{512} = \{1,2,3,4,5,6,7,8,9\}$

$D_{56} = \{1,2,3,4,5,6,7,8,8\}$ $D_{513} = \{1,2,3,4,5,6,8,9\}$

$D_{57} = \{1,4,5,6,7,8,9\}$ $D_{514} = \{1,2,3,4,5,6,7,8,9\}$

$D_{58} = \{1,2,3,4,5,6,7,8,9\}$ $D_{515} = \{1,2,3,4,5,6,7,8,9\}$

The sets of discordance for alternative 6 is,

$D_{61} = \{1,2,3,4,6,7,9\}$ $D_{69} = \{\ \}$

$D_{62} = \{1,2,3,4\}$ $D_{610} = \{\ \}$

$D_{63} = \{2,3,4,7\}$ $D_{611} = \{1,2,3,4,5,6,7\}$

$D_{64} = \{\ \}$ $D_{612} = \{1,2,3,4,6\}$

$D_{65} = \{\ \}$ $D_{613} = \{2,4,6,8\}$

$D_{67} = \{4,8\}$ $D_{614} = \{2,3,4,5,6,7\}$

$D_{68} = \{1,2,3,4,6,7,8,9\}$ $D_{615} = \{1,2,3,4,5,6,8\}$

The sets of concor6dance for alternative 7 is,

$D_{71} = \{1,2,3,4,6,7,9\}$ $D_{79} = \{\ \}$

$D_{72} = \{1,2,3,4,6,9\}$ $D_{710} = \{\ \}$

$D_{73} = \{2,3,4,6,7\}$ $D_{711} = \{1,2,3,4,5,6,7\}$

$D_{74} = \{\ \}$ $D_{712} = \{1,2,3,4,5,6\}$

$D_{75} = \{\ \}$ $D_{713} = \{2,3,4,6\}$

$D_{76} = \{3,5,6,9\}$ $D_{714} = \{2,3,4,5,6,7,8\}$

$D_{78} = \{1,2,3,4,5,6,7,8,9\}$ $D_{715} = \{1,2,3,4,5,6,8\}$

The sets of discordance for alternative 8 is,

$D_{81} = \{\ \}$ $D_{89} = \{\ \}$

$D_{82} = \{\ \}$ $D_{810} = \{\ \}$

$D_{83} = \{\ \}$ $D_{811} = \{3,5\}$

$D_{84} = \{\ \}$ $D_{812} = \{\ \}$

$D_{85} = \{\ \}$ $D_{813} = \{\ \}$

$D_{86} = \{\ \}$ $D_{814} = \{2,5\}$

$D_{87} = \{\ \}$ $D_{815} = \{5\}$

The sets of discordance for alternative 9 is,

$D_{91} = \{1,2,3,4,5,6,7,8,9\}$ $D_{98} = \{1,2,3,4,5,6,7,8,9\}$

$D_{92} = \{1,2,3,4,5,6,7,8,9\}$ $D_{910} = \{1,2,3,4,7,9\}$

$D_{93} = \{1,2,3,4,6,7,9\}$ $D_{911} = \{1,2,3,4,5,6,7,8,9\}$

$D_{94} = \{1,2,3,6,7,9\}$ $D_{912} = \{1,2,3,4,5,6,7,8,9\}$

$D_{95} = \{1,2,3,4,7,9\}$ $D_{913} = \{1,2,3,4,5,6,7,8,9\}$

$D_{96} = \{1,2,3,4,5,6,7,8,9\}$ $D_{914} = \{1,2,3,4,5,6,7,8,9\}$

$D_{97} = \{1,2,3,4,5,6,7,8,9\}$ $D_{915} = \{1,2,3,4,5,6,7,8,9\}$

The sets of discordance for alternative 10 is,

$D_{101} = \{1,2,3,4,5,6,7,8,9\}$ $D_{108} = \{1,2,3,4,5,6,7,8,9\}$

$D_{102} = \{1,2,3,4,6,7,9\}$ $D_{109} = \{5,6,8\}$

$D_{103} = \{1,2,3,4,6,7,9\}$ $D_{1011} = \{1,2,3,4,5,6,7,8,9\}$

$D_{104} = \{2,6,7,8\}$ $D_{1012} = \{1,2,3,4,5,6,7,8,9\}$

$D_{105} = \{1,2,3,4,7,8\}$ $D_{1013} = \{1,2,3,4,5,6,7,8,9\}$

$D_{106} = \{1,2,3,4,5,6,7,8,9\}$ $D_{1014} = \{1,2,3,4,5,6,7,8,9\}$

$D_{107} = \{1,2,3,4,5,6,7,8,9\}$ $D_{1015} = \{1,2,3,4,5,6,7,8,9\}$

The sets of discordance for alternative 11 is,

$D_{111} = \{\ \}$ $D_{118} = \{2,4,6,8,9\}$

$D_{112} = \{\ \}$ $D_{119} = \{\ \}$

$D_{113} = \{\ \}$ $D_{1110} = \{\ \}$

$D_{114} = \{\ \}$ $D_{1112} = \{6\}$

$D_{115} = \{\ \}$ $D_{1113} = \{8\}$

$D_{116} = \{8.9\}$ $D_{1114} = \{2,5,6,8\}$

$D_{117} = \{8\}$ $D_{1115} = \{5,6,8\}$

The sets of discordance for alternative 12 is,

$D_{121} = \{1,2,3,7,8,9\}$ $D_{128} = \{1,2,3,4,6,7,8,9\}$

$D_{122} = \{3,9\}$ $D_{129} = \{\ \}$

$D_{123} = \{2,7\}$ $D_{1210} = \{\ \}$

$D_{124} = \{\ \}$ $D_{1211} = \{1,2,3,4,5,7,8,9\}$

$D_{125} = \{\ \}$ $D_{1213} = \{8,9\}$

$D_{126} = \{8.9\}$ $D_{1214} = \{2,3,4,5,6,7,8,9\}$

$D_{127} = \{8,9\}$ $D_{1215} = \{3,4,5,8\}$

The sets of discordance for alternative 13 is,

$D_{131} = \{1,2,3,6,7,9\}$ $D_{138} = \{1,2,3,4,5,6,7,8,9\}$

$D_{132} = \{1,2,3,4,7,9\}$ $D_{139} = \{\ \}$

$D_{133} = \{1,2,3,7\}$ $D_{1310} = \{\ \}$

$D_{134} = \{\ \}$ $D_{1311} = \{1,2,3,4,5,7,9\}$

$D_{135} = \{\ \}$ $D_{1312} = \{1,2,3,4,5,6,7\}$

$D_{136} = \{1,5,7,9\}$ $D_{1314} = \{1,2,3,4,5,6,7,8,9\}$

$D_{137} = \{1,7,9\}$ $D_{1315} = \{1,2,3,4,5,6,7,8\}$

The sets of discordance for alternative 14 is,

$D_{141} = \{1,7,9\}$ $D_{148} = \{1,3,4,6,7,8,9\}$

$D_{142} = \{1,3,9\}$ $D_{149} = \{\ \}$

$D_{143} = \{\ \}$ $D_{1410} = \{\ \}$

$D_{144} = \{\ \}$ $D_{1411} = \{1,3,7\}$

$D_{145} = \{\ \}$ $D_{1412} = \{1\}$

$D_{146} = \{9\}$ $D_{1413} = \{\ \}$

$D_{147} = \{\ \}$ $D_{1415} = \{1,3,5\}$

The sets of discordance for alternative 15 is,

$D_{151} = \{1,2,7,9\}$ $D_{158} = \{1,2,4,6,7,8,9\}$

$D_{152} = \{2,9\}$ $D_{159} = \{\ \}$

$D_{153} = \{2,7\}$ $D_{1510} = \{\ \}$

$D_{154} = \{\ \}$ $D_{1511} = \{1,2,3,7,9\}$

$D_{155} = \{\ \}$ $D_{1512} = \{2,7\}$

$D_{156} = \{7,9\}$ $D_{1513} = \{9\}$

$D_{157} = \{7,9\}$ $D_{1514} = \{2,6,7,9\}$

The sets of discordance for alternative 13 is,

$D_{131} = \{1,2,3,6,7,9\}$ $D_{138} = \{1,2,3,4,5,6,7,8,9\}$

$D_{132} = \{1,2,3,4,7,9\}$ $D_{139} = \{\ \}$

$D_{133} = \{1,2,3,7\}$ $D_{1310} = \{\ \}$

$D_{134} = \{\ \}$ $D_{1311} = \{1,2,3,4,5,7,9\}$

$D_{135} = \{\ \}$ $D_{1312} = \{1,2,3,4,5,6,7\}$

$D_{136} = \{1,5,7,9\}$ $D_{1314} = \{1,2,3,4,5,6,7,8,9\}$

$D_{137} = \{1,7,9\}$ $D_{1315} = \{1,2,3,4,5,6,7,8\}$

The sets of discordance for alternative 14 is,

$D_{141} = \{1,7,9\}$ $D_{148} = \{1,3,4,6,7,8,9\}$

$D_{142} = \{1,3,9\}$ $D_{149} = \{\ \}$

$D_{143} = \{\ \}$ $D_{1410} = \{\ \}$

$D_{144} = \{\ \}$ $D_{1411} = \{1,3,7\}$

$D_{145} = \{\ \}$ $D_{1412} = \{1\}$

$D_{146} = \{9\}$ $D_{1413} = \{\ \}$

$D_{147} = \{\ \}$ $D_{1415} = \{1,3,5\}$

The sets of discordance for alternative 15 is,

$D_{151} = \{1,2,7,9\}$ $D_{158} = \{1,2,4,6,7,8,9\}$

$D_{152} = \{2,9\}$ $D_{159} = \{\ \}$

$D_{153} = \{2,7\}$ $D_{1510} = \{\ \}$

$D_{154} = \{\ \}$ $D_{1511} = \{1,2,3,7,9\}$

$D_{155} = \{\ \}$ $D_{1512} = \{2,7\}$

$D_{156} = \{7,9\}$ $D_{1513} = \{9\}$

$D_{157} = \{7,9\}$ $D_{1514} = \{2,6,7,9\}$

Concordance Matrix

$$c_{kl} = \sum_{j \in c_{kl}} w_j$$

Wet Rice	0	80.5	100	100	100	83.4	91	23.5	100	100	59.2	70.4	91	49.5	49.1
Corn	19.5	0	74.4	100	100	69.7	69.7	12.3	100	100	8.8	49.2	68.6	35.8	46.7
Chili	19.1	25.6	0	91	91	59.8	74.6	0	83.4	100	11.9	37.9	59.8	14.7	25.6
Chayote	0	0	9	0	53.9	0	0	0	85.2	70.5	0	0	13.7	0	0
Avocado	0	0	9	77.6	0	11.9	24.2	0	77.6	77.6	0	0	13.7	0	0
Papaya	16.6	53.9	54.9	100	100	0	83.8	7.6	100	100	17.8	39.1	57.1	23.5	22.5
Kencur	16.6	30.3	40.1	100	100	56.5	0	0	100	100	17.8	31.5	53.8	23.5	22.5
Diary Cows Farmery	100	100	100	100	100	100	100	0	100	100	80.1	100	100	80.5	92.4
Quail Bird Farmery	0	0	16.6	23.8	31.4	0	0	0	0	31.4	0	0	0	0	0
Quail Bird Egg	0	0	16.6	50.6	31.2	0	0	0	68.6	0	0	0	0	0	0
Cow's Milk	76.4	91.2	100	100	100	82.2	91	48.3	100	100	0	85.2	91	56.7	68.6
Tobacco Industry	29.6	78.9	74.4	100	100	82.2	82.2	7.6	100	100	14.8	0	82.2	14.7	63.9
Wood Goods & Webbing Industry	23.8	31.4	47.4	100	100	55.2	62.8	0	100	100	23.8	17.8	0	0	8.8
Furniture Industry	62.8	64.2	100	100	100	91.2	100	19.5	100	100	59.3	85.3	100	0	65.4
Metal Goods Industry	50.9	79.3	74.4	100	100	77.5	77.5	19.9	100	100	38.6	74.4	91.2	50.8	0

Discordance Matrix

$$d_{kl} = \frac{max\{|v_{kj} - v_{ij}|\}_{j \in D_{kl}}}{max\{|v_{kj} - v_{ij}|\}_{\forall_j}}$$

Wet Rice	0	1	1	1	1	1	1	0	1	1	0.93	1	1	1	0.66
Corn	0.19	0	1	1	1	1	1	0	1	1	0.11	0.86	1	0.28	0.25
Chili	0	0.59	0	1	1	0.59	0.52	0	1	1	0	0.22	0.68	0	0.20
Chayote	0	0	0.11	0	1	0	0	0	1	1	0	0	0	0	0
Avocado	0	0	0.07	0.68	0	0	0	0	1	1	0	0	0	0	0
Papaya	0.11	0.83	1	1	1	0	1	0	1	1	0.11	0.95	1	0.09	0.36
Kencur	0.22	0.83	1	1	1	0.35	0	0	1	1	0.22	0.71	1	0	0.22
Diary Cows Farmery	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1
Quail Bird Farmery	0	0	0.13	0.50	0.69	0	0	0	0	0.40	0	0	0	0	0
Quail Bird Egg	0	0	0	0.91	0.80	0	0	0	1	0	0	0	0	0	0
Cow's Milk	1	1	1	1	1	1	1	0.34	1	1	0	1	1	1	1
Tobacco Industry	0.27	1	1	1	1	1	1	0	1	1	0.46	0	1	0.55	0.18
Wood Goods & Webbing Industry	0.16	0.78	1	1	1	0.30	0.86	0	1	1	0.16	0.65	0	0	0.11
Furniture Industry	0.78	1	1	1	1	1	1	0.69	1	1	0.63	1	1	0	1
Metal Goods Industry	1	1	1	1	1	1	1	0.95	1	1	0.74	1	1	0.55	0

Dominant Concordance Matrix

Threshold Value

$$c = \frac{\sum_{k=1}^{m}\sum_{l=1}^{m} c_{kl}}{m(m-1)} = 53.5119$$

Wet Rice	0	1	1	1	1	1	1	0	1	1	1	1	1	0	0
Corn	0	0	1	1	1	1	1	0	1	1	0	0	1	0	0
Chili	0	0	0	1	1	1	1	0	1	1	0	0	1	0	0
Chayote	0	0	0	0	1	0	0	0	1	1	0	0	0	0	0
Avocado	0	0	0	1	0	0	0	0	1	1	0	0	0	0	0
Papaya	0	1	1	1	1	0	1	0	1	1	0	0	1	0	0
Kencur	0	0	0	1	1	1	0	0	1	1	0	0	1	0	0
Diary Cows Farmery	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1
Quail Bird Farmery	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Quail Bird Egg	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Cow's Milk	1	1	1	1	1	1	1	0	1	1	0	1	1	1	1
Tobacco Industry	0	1	1	1	1	1	1	0	1	1	0	0	1	0	1
Wood Goods & Webbing Industry	0	0	0	1	1	1	1	0	1	1	0	0	0	0	0
Furniture Industry	1	1	1	1	1	1	1	0	1	1	1	1	1	0	1
Metal Goods Industry	0	1	1	1	1	1	1	0	1	1	0	1	1	0	0

Dominant Discordance Matrix

Threshold Value

$$d = \frac{\sum_{k=1}^{m}\sum_{l=1}^{m} d_{kl}}{m(m-1)} = 0.6166$$

Wet Rice	0	1	1	1	1	1	1	0	1	1	1	1	1	1	1
Corn	0	0	1	1	1	1	1	0	1	1	0	1	1	0	0
Chili	0	0	0	1	1	0	0	0	1	1	0	0	1	0	0
Chayote	0	0	0	0	1	0	0	0	1	1	0	0	0	0	0
Avocado	0	0	0	1	0	0	0	0	1	1	0	0	0	0	0
Papaya	0	1	1	1	1	0	1	0	1	1	0	1	1	0	0
Kencur	0	1	1	1	1	0	0	0	1	1	0	1	1	0	0
Diary Cows Farmery	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1
Quail Bird Farmery	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Quail Bird Egg	0	0	0	1	1	0	0	0	1	0	0	0	0	0	0
Cow's Milk	1	1	1	1	1	1	1	0	1	1	0	1	1	1	1
Tobacco Industry	0	1	1	1	1	1	1	0	1	1	0	0	1	0	0
Wood Goods & Webbing Industry	0	1	1	1	1	0	1	0	1	1	0	1	0	0	0
Furniture Industry	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1
Metal Goods Industry	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0

Aggregate Dominance Matrix

$e_{kl} = f_{kl} x g_{kl}$

Wet Rice	0	1	1	1	1	1	1	0	1	1	1	1	1	0	0
Corn	0	0	1	1	1	1	1	0	1	1	0	0	1	0	0
Chili	0	0	0	1	1	0	0	0	1	1	0	0	1	0	0
Chayote	0	0	0	0	1	0	0	0	1	1	0	0	0	0	0
Avocado	0	0	0	1	0	0	0	0	1	1	0	0	0	0	0
Papaya	0	1	1	1	1	0	1	0	1	1	0	0	1	0	0
Kencur	0	0	0	1	1	0	0	0	1	1	0	0	1	0	0
Diary Cows Farmery	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1
Quail Bird Farmery	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Quail Bird Egg	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Cow's Milk	1	1	1	1	1	1	1	0	1	1	0	1	1	1	1
Tobacco Industry	0	1	1	1	1	1	1	0	1	1	0	0	1	0	0
Wood Goods & Webbing Industry	0	0	0	1	1	0	1	0	1	1	0	0	0	0	0
Furniture Industry	1	1	1	1	1	1	1	0	1	1	1	1	1	0	1
Metal Goods Industry	0	1	1	1	1	1	1	0	1	1	0	1	1	0	0

CHAPTER VI
CONCLUSIONS AND RECOMMENDATIONS

This chapter consists the conclusion obtained from the analysis of Multi-Criteria Decision-Making analysis and interpretation. In addition, this chapter will has some recommendation for similiar future research.

6.1 Conclusion

Based on the data processing, analysis, and interpretation, the several conclusions that can be drawn are:

1. Based on the calculation using Location Quotient method, ELECTRE method, and analysis of both primary and secondary data, the best competitive commodity, which may be the economic driver of Boyolali regency, is dairy cattle livestock. Some other potential commodity are cow's milk commodity and furniture industry.
2. Based on value chain analysis of dairy cattle livestock, there are several value activities need to be improved. From primary activities, there are some obstacles from illegal broker in the dairy cattle. The government of Boyolali need to make sure the number of sales of the product. There are several market target for dairy cattle product such as small medium enterprise, local industry, or other regency or province. In supporting activities, the improvement come from the interal of the livestocks in Boyolali. Most of the livestock's employee is paid below the minimum wages in Boyolali. Some improvement that can be implied by the livestocks is hire less employee with higher skills. More productive employee will reduce the number of employee needed. The average profit margin is Rp 217.500.000,00 or 39% from the outcome of the livestock per 300 lactation days per 28 cows by calculation from one of the dairy cattle livestock in Mojosongo, Boyolali.

3. The core competencies of dairy cattle livestock commodity in Boyolali is the cows breeding and milk production. Some improvement will enhance the commodity and the economy significantly. The improvement is in technologies, skill, and knowledge of the core competencies.

6.2 Recommendation

Some recoemmendation for similiar further research:

1. Dairy cattle commodity as the featured competitive commodity in Boyolali need more support from other region that not involved in the commodity yet. The commodity spreaded into six different district in Boyolali. To be able to run the strategy based on the value chain analysis, all of the district and triple helix contributors need to take part in the development of the commodity.
2. This research already analyze the core competencies of the dairy cattle commodity. Therefore, to reach the optimum productivity, the commodity need further research about more technical core competencies analysis with experts from another field about how to manage the commodity in more specific strategy.
3. Consider the data provided by the government of the object. Some data is quite hard to obtain and it took long time for the government to provide accurate data in the previous year. It need strong assumption that the latest data provided is useable for the research.

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